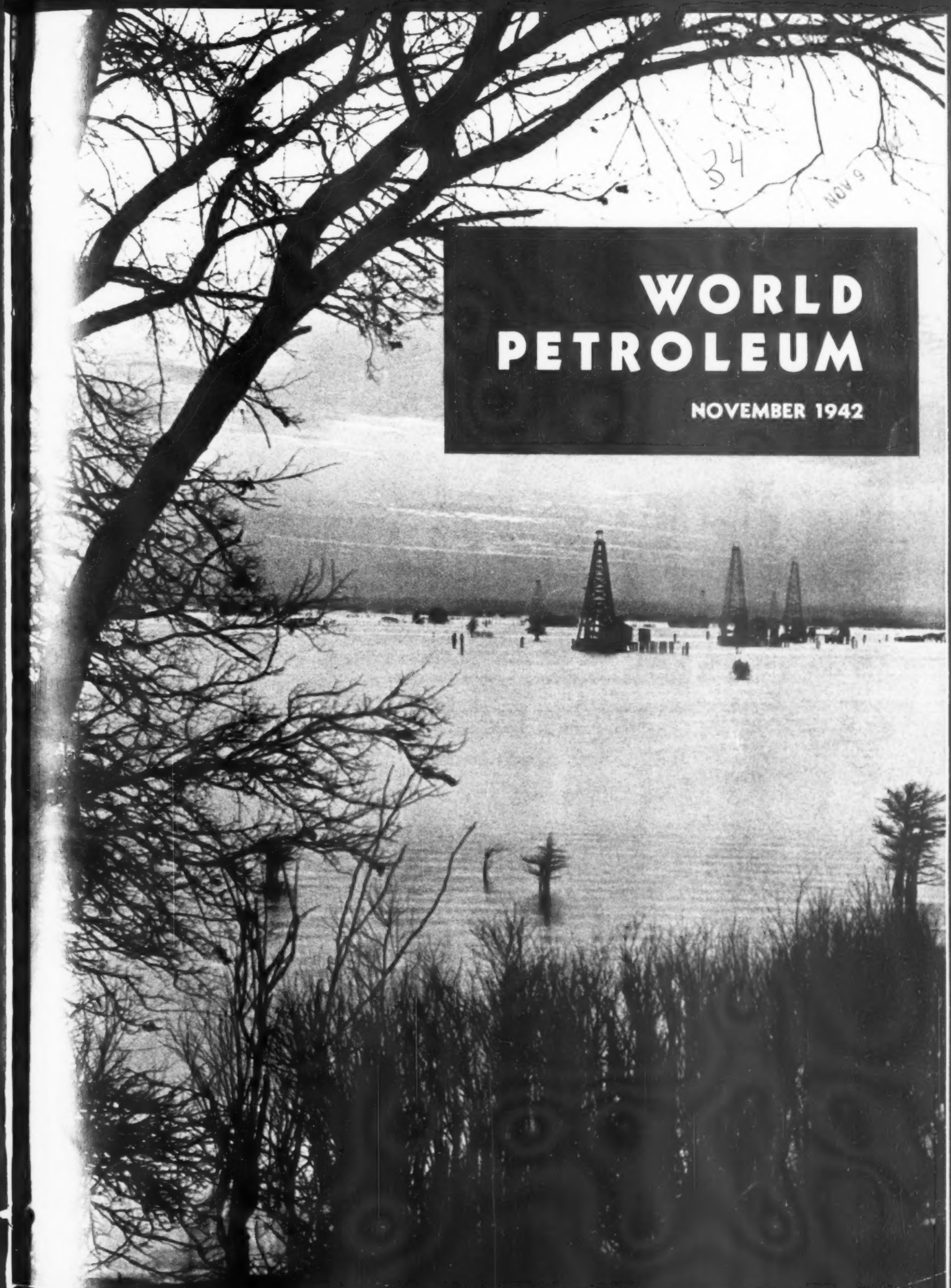
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THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

VOLUME 13 NOVEMBER, 1942 NUMBER 12

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EDITORIAL

RESERVES AND PRODUCTION—A FUNDAMENTAL PROBLEM

REALIZATION of the tremendous drafts that mounting war demands are going to make upon American oil supplies is forcing renewed consideration of the industry's most fundamental need, a need that has been neglected in the rush of war preparations. The situation presents a twofold necessity: first, the continuance in operation of every producing well in such manner as to insure maximum recovery; second, the early replenishment of reserves on which depends the ability to meet increasing demands for petroleum in the future. Army and Navy requirements and the needs of allied nations are rising rapidly with the growth of fighting forces. The time appears not far distant when half the country's current production must be earmarked for the satisfaction of these demands. Meanwhile the growth in reserves needed to sustain greater production is not taking place. Statistics of wildcat drilling reveal a sharp decline in the number of wells drilled and a still greater decrease in the amount of new oil per well. Opportunity for a full discussion of the problems of reserves and production was afforded by the hearings conducted during the past month by the minerals sub-committee of the Senate Committee on Public Lands and the statements submitted at these hearings placed the situation, its causes and the logical remedy clearly on record.

Salient facts presented at the hearings may be summarized as follows: for several years the volume of oil discovered per wildcat well drilled has steadily declined; the size of new fields discovered has decreased; the cost of putting down wells, per well and per foot, has risen; a sharp decline in exploratory drilling has taken place in 1942, while the proportion of dry holes has risen; the inescapable conclusion is that to find new sources of supply adequate to support increased production the search for oil must be intensified and more wildcat drilling must be done.

Statistics extending over the past twenty years and more show that the key factor governing the search for oil is the monetary return which oil itself commands. They reveal a close and constant relationship between the price of crude and the extent of exploratory drilling. The reason for this is obvious since only one in five or six holes drilled results in actual production and the industry's earnings must pay for the failures.

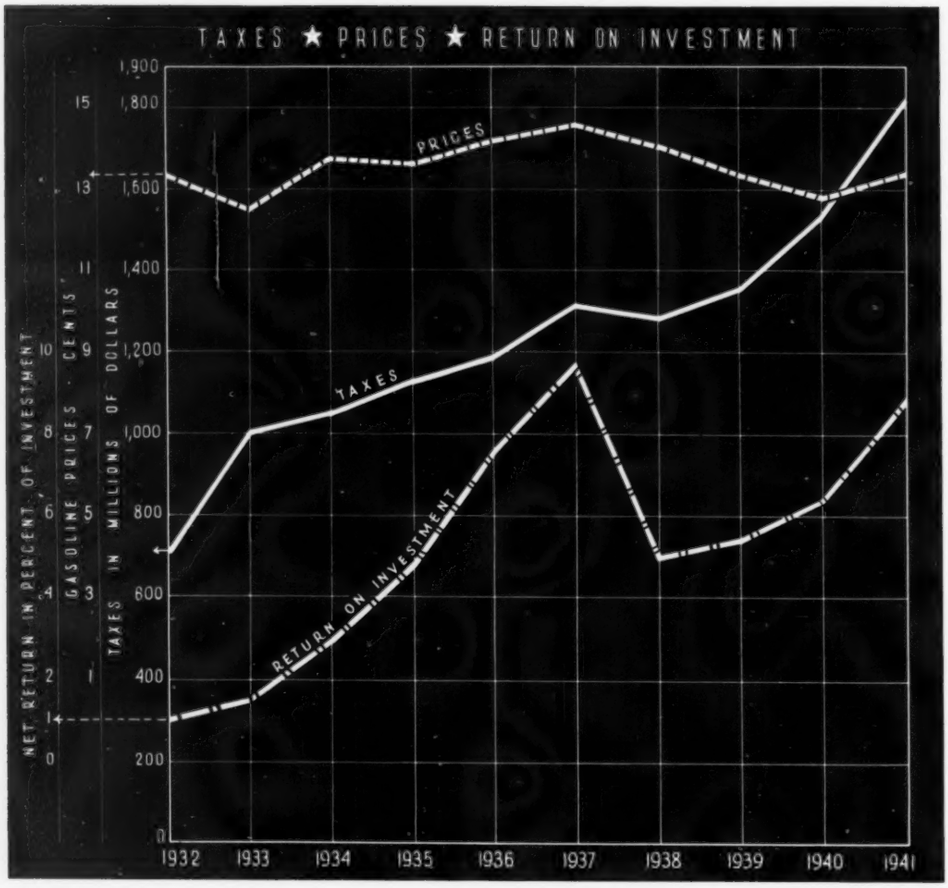
Among men familiar with conditions governing oil exploration and the building up of national reserves agreement is complete that the essential requirement for an improved rate of discovery is a price for crude that will provide an incentive to undertake the hazards of wildcat drilling. Petroleum Coordinator Ickes has publicly stated that "it may well be that price advances should be made in the light of present-day costs and to stimulate much-needed new development." The Petroleum Industry War Council, the Interstate Compact Commission, the National Conference of Petroleum Regulatory Authorities, and other representative bodies have voiced by resolution their opinion that an upward revision of prices is necessary to provide imperatively needed additions to reserves and to maintain production at an adequate level.

Price Administrator Henderson rejects this expert opinion and declares himself unalterably opposed to a general price advance. He suggests vaguely that the situation can be met by local readjustments in prices or by payment of a bonus for new production, but he has offered no feasible plan embodying such proposals. The stock objection to price advances in other commodities, namely that they contribute to inflation, does not apply since the amount of petroleum products that consumers are allowed to purchase is closely regulated.

Even if it were possible, by subsidizing wildcat drilling, to stimulate the location of new reserves it obviously would provide no answer to the second half of the problem which is to keep in operation hundreds of thousands of small wells many of which can produce only at a loss under present ceiling prices. These wells in the aggregate are of tremendous importance to the nation but they are being abandoned at an alarming rate because their owners cannot afford to keep them going. Ralph T. Zook pointed out to the Senate sub-committee that three-fourths of all the producing wells in the United States are in the stripper class of marginal production. By maintaining them as producers and by applying sound methods of secondary recovery it is estimated that 2,000,000,000 to 3,000,000,000 barrels of oil can be added at an increased cost to the national supply. Abandonment of these wells would mean the irreparable loss of all this oil.

Responsibility not only for the immediate future of the oil industry but for the future industrial efficiency of the nation rests in Mr. Henderson's hands. What will he do with it?

View showing a condensate drum in an alkylation unit. Photo by Ulric Meisel.



OIL COMPANY EARNINGS DEPRESSED BY GOVERNMENT WAR DIRECTIVES

By Henry E. Rose

Return on Capital Invested in Oil Industry Lower Than Other Representative Industries—Necessary War Readjustments Threaten Further Reductions in Earnings.

OPERATING under a war economy the American petroleum industry is undergoing financial changes which may react on its future development. The effect of governmental policies, stemming from all-out efforts to prosecute the war, are depressing the return on investment—already the lowest when compared with all other American industry—and preventing the accumulation of adequate financial "meat on the bone" to assure maintenance of oil's position in raw material supply, as an example. These policies, if continued indefinitely, will also affect other divisions of the industry.

Summarized, the war-time charges entail:

(a) Forced transition of the industry to a major producer of fuel oils (less profitable), from one which, over a period of years, has been geared as a primary producer of gasoline;

(b) Increased normal federal taxation accompanied by an unremitting effort on the part of governmental administration officials to reduce, or eliminate, depletion allowances applicable to the development of new crude oil reserves;

(c) Higher operating costs (labor, materials, transportation, etc.) with little, or no, prospect of an upward revision in ceiling prices established by the governmental Office of Price Administration. (Recently, however provision was made to compensate east coast operators for their higher transportation costs via rail and pipe line as against normal tanker deliveries.)

The trend of investment return for the American oil industry has been downward in the past year in reflection of these various factors as well as by rationing in certain parts of the country because of transportation problems. The industry at no time in years (except 1932) has yielded a return on its investment comparable to that for American industry as a whole.

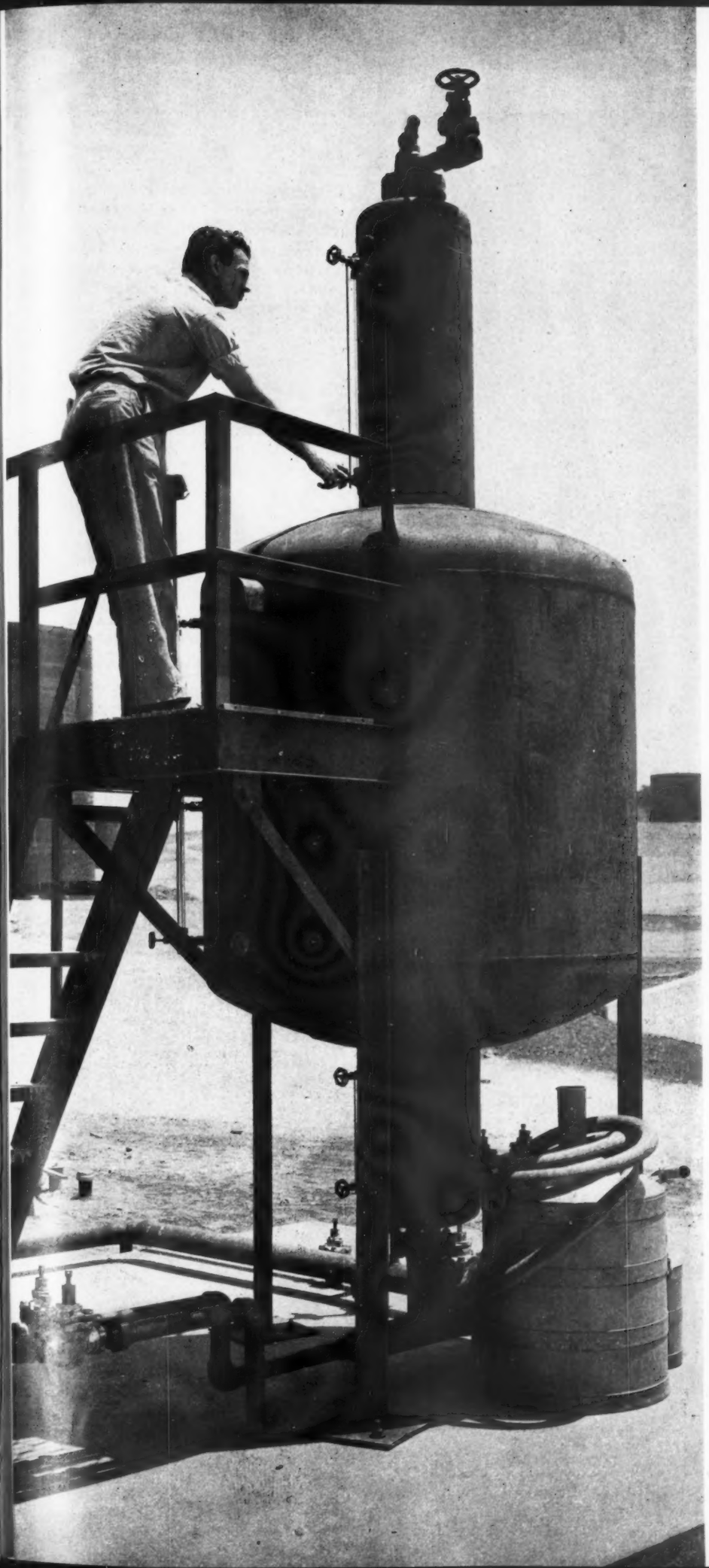
In a breakdown of 22 industries compiled by the National City Bank of New York, for instance, and giving investment returns for the first six months of this year, the profits of nine companies in the petroleum group (there are 290 industrials in the compilation), related to net worth, showed a yield of 5.8 percent on an annual basis, the second lowest of the 22 industries. The only group below oil was stone, clay and glass (eight companies), whose return on investment was equal to 5.4 percent on an annual basis. Heading the industry group in the National City's tabulation were auto equipment companies which realized a return of 15.8 percent in this year's first half. They were followed by mining, quarrying, etc., with a return of 12.3 percent; metal mining with 11.3 percent; machinery 11.2 percent; office equipment 11.2 percent; electrical equipment 10.1 percent; food and beverages 10.6 percent and metal manufacturing companies 9.7 percent.

Factors diminishing profits by petroleum companies in the first six months of this year, aside from more burdensome taxation, were rationing of products on the eastern seaboard resulting in higher operating costs to handle a smaller volume, and increased transportation expenses.

In a compilation of 24 petroleum companies, whose shares are listed on recognized securities exchanges, John D. Gill, of Atlantic Refining Co., shows that their aggregate profits in the first six months of 1942, totaling $165.4 million, were equal, on an annual basis, to a return of only 5.9 percent on their net worth (investment) of $5,612 million. Net worth comprises outstanding capital and surplus, but excludes surplus reserves. In contrast, the 290 companies of all kinds used in the National City Bank tabulation had a net return on capital equal to 7.5 percent, or 27 percent more than that for the petroleum industry.

In the first six months of 1941, by comparison, the return for the oil industry, while it was higher (7.4 percent) in reflection of better prices, was still 40 percent below that for all companies used in the National City Bank tabulation.

In 1941, according to Mr. Gill's compilation, the 24 oil companies netted 8.8 percent on their net worth against 11.6 percent netted by 400 industrial corporations. During the present governmental (New Deal) administration, embracing the years 1933 to 1941, inclusive, the 24 oil companies' net return on investment averaged 5.8 percent. By comparison, all industry, as represented by the 400 corporations, yielded 7.8 percent.



The accompanying tabulation shows percentage return on net worth for the petroleum industry and for a larger number of companies in all industry, for the first six months of this year and 1941, and for years 1941 back to 1931, as well as averages for the New Deal period of government and for the 1927-1941 period.

From this array of statistics it is clearly evident that the petroleum industry has not been profiteering, and thus should be free of criticism in this direction. The compilations do show, moreover, that the industry is not earning sufficient to carry on its normal operations of development and exploration. The nature of the industry, with an irreplacable raw material, and no re-usable products, necessitates constant and continuing expenditure to replenish usable resources.

In the past three years, as an instance, the rate of new oil discovery (aside from extensions of older fields and revisions in estimates of presently existing reserves) has fallen below withdrawals. While the industry, normally, has maintained a crude oil reserve position with an estimated life ranging from seven to 15 years, this yardstick may not be of value in coming years, especially after the war.

The sole determinant will be whether or not the country's oil wells, with reserves equal to 15 years under ground, will be able, economically, to produce at one time sufficient oil to meet demands. That is, will the industry be capable of furnishing an average daily rate of, say, 4,500,000 bbl. even with its strong reserve position?

If the war should end in the near future, it is not inconceivable that demands upon the American industry will be far in excess of what they had been in the recent past. This is predicated on the destruction of important oil producing fields in the Dutch East Indies, Burma, Russia and elsewhere because of war, and the reliance, for several years at least, on American supplies.

This year's drilling operations in the United States, unfortunately, will fall approximately 50 percent below last year and well below normal. Curtailment is the result of restrictions on the use of critical materials needed for defense purposes. The ever-widening forecasts of critical materials—steel, copper, etc.—in the war effort preclude any hope that the oil industry may expect a substantial easing of restrictions on drilling equipment soon. Its development work, hence, will be retarded accordingly.

It is this important division of the industry which, when materials again become freely available, will witness a sharply higher rate of exploration and development. This will require finances, some of which will have to be accumulated from current operations. Thus, if a satis-

Left: Operator at a pipe line pumping station checking gauge on a calibration tank which is used to check the accuracy of meters which constantly measure the amount of product flowing through the line and out of it to various delivery points.

COMPARISON ANNUAL RETURN IN PERCENT OF NET WORTH BETWEEN OIL COMPANIES AND OTHER INDUSTRIAL COMPANIES

	TWENTY-FOUR OIL COMPANIES			FOUR HUNDRED INDUSTRIAL COMPANIES		
	NET WORTH (Millions)	NET PROFIT (Millions)	ANNUAL RETURN IN PERCENT OF NET WORTH	NET WORTH (Millions)	NET PROFIT (Millions)	ANNUAL RETURN IN PERCENT OF NET WORTH
Six months						
1942	$5,612	$165.4	5.9	$12,626	$474.5	7.5
1941	5,630	208.3	7.4	12,181	725.2	11.9
Years						
1941	5,963	524.6	8.8	23,667	2,752	11.6
1940	5,854	369.5	6.3	23,144	2,287	9.9
1939	5,888	312.9	5.3	22,737	1,869	8.2
1938	5,804	289.9	5.0	22,787	1,203	5.3
1937	5,789	562.2	9.7	22,844	2,416	10.6
1936	5,440	410.0	7.5	21,942	2,145	9.8
1935	5,247	251.9	4.8	21,330	1,431	6.7
1934	5,104	152.6	2.9	21,110	956	4.5
1933	5,583	77.9	1.4	21,724	632	2.9
1932	5,651	53.9	1.0	22,024	69	0.3
1931	6,096	(d) 96.0	(d) 1.6	23,730	631	2.7
Average						
1933-1941	5,640	327.9	5.8	22,365	1,743	7.8
1927-1941	5,789	310.9	5.4	22,730	1,721	7.6

Footnote: Oil company data compiled by John D. Gill, Atlantic Refining Co.; Data for industrial companies compiled by Poor's & Standard Statistics through 1939, extended through 1941 by John D. Gill. Oil company figures for 1941 & 1942 cover 25 companies; Industrial company figures for 1941 & 1942 cover 290 companies used by National City Bank of New York. Oil companies net worth represents net stock & surplus but excludes surplus reserves.

factory return on capital is not yielded, the industry will be forced to borrow heavily in money markets.

Of a gross investment in the oil industry in this country estimated at about $15,000 million, approximately 60 percent has been in crude oil production and crude oil pipelines. The industry has grown to its present imposing size through re-investment of earnings and capital charges, its debt structure being relatively small, and representing less than 15 percent of its combined capital.

The gross and net investment in the United States' petroleum industry, as calculated by Dr. Gill and James S. Weatherby of the Atlantic Refining Co., in 1940, is made up by the following divisions:

	Gross Plant (In millions of dollars)	Net Plant	Gross Including (1) Other Assets
Crude oil production (2)	$ 7,400	$3,440	$ 7,850
Crude oil pipelines	982	431	1,027
Marine Transportation	528	224	550
Refining	1,936	897	2,467
Tank Cars	255	92	262
Refined Products Pipelines	99	68	106
Marketing	2,170	1,404	2,638
Administrative & Misc.	150	100	150
Totals	$13,520	$ 6,656	$15,044

(1) Principally inventories of crude, products, material and supplies and net working capital.

(2) Includes oil industry's investment in natural gasoline plants—also gas producing properties where inseparable from oil properties, but investments of natural gas companies are not included.

One of the government's directives to the industry which now is imposing hardship is that compelling the production of more fuel oils—secondary, less profitable products—as against the industry's normally major profit product of gasoline. The directive affects the industry in the east, middle west and southwest, and embraces approximately 80 percent of the country's refining facilities.

Below: Tug "Huster" moving oil barge across New York Harbor.

These adjustments will mean a substantial reduction in refinery income per barrel of crude oil processed. In a recent recommendation that the average yield of gasoline from a barrel of crude be reduced to 37.1 percent from 46 percent for all of 1941, it was estimated by the industry's committee on economics that about 270,000 bbl. of gasoline daily must be degraded to lower valued products, principally residual fuel oil, in the period from August 1, 1942 to March 31, 1943.

The Committee further estimated that on the basis of differentials in current ceiling prices in these districts, this means a reduction in refinery income of approximately $350,000 a day as compared with the income which the refiners would obtain on the hypothesis that they ran the forecast barrels of crude, obtained the average 1941 yields, and sold the products at current ceiling prices.

Thus, if ceiling prices on lower grade products are not elevated, it is axiomatic that the industry in these districts stands to lose approximately 14 cents a barrel of crude oil processed. This, translated into refined products, would mean an increase in the price of gasoline of about 1 cent a gallon, or an average of ½ cent a gallon on the four major products—gasoline, kerosene, gas oil and distillate and residual fuel oil. Another method by which these higher costs could be offset is by the payment to refiners of an amount sufficient to cover the losses imposed by operating changes similar to the arrangement now prevailing for east coast operators on transportation.

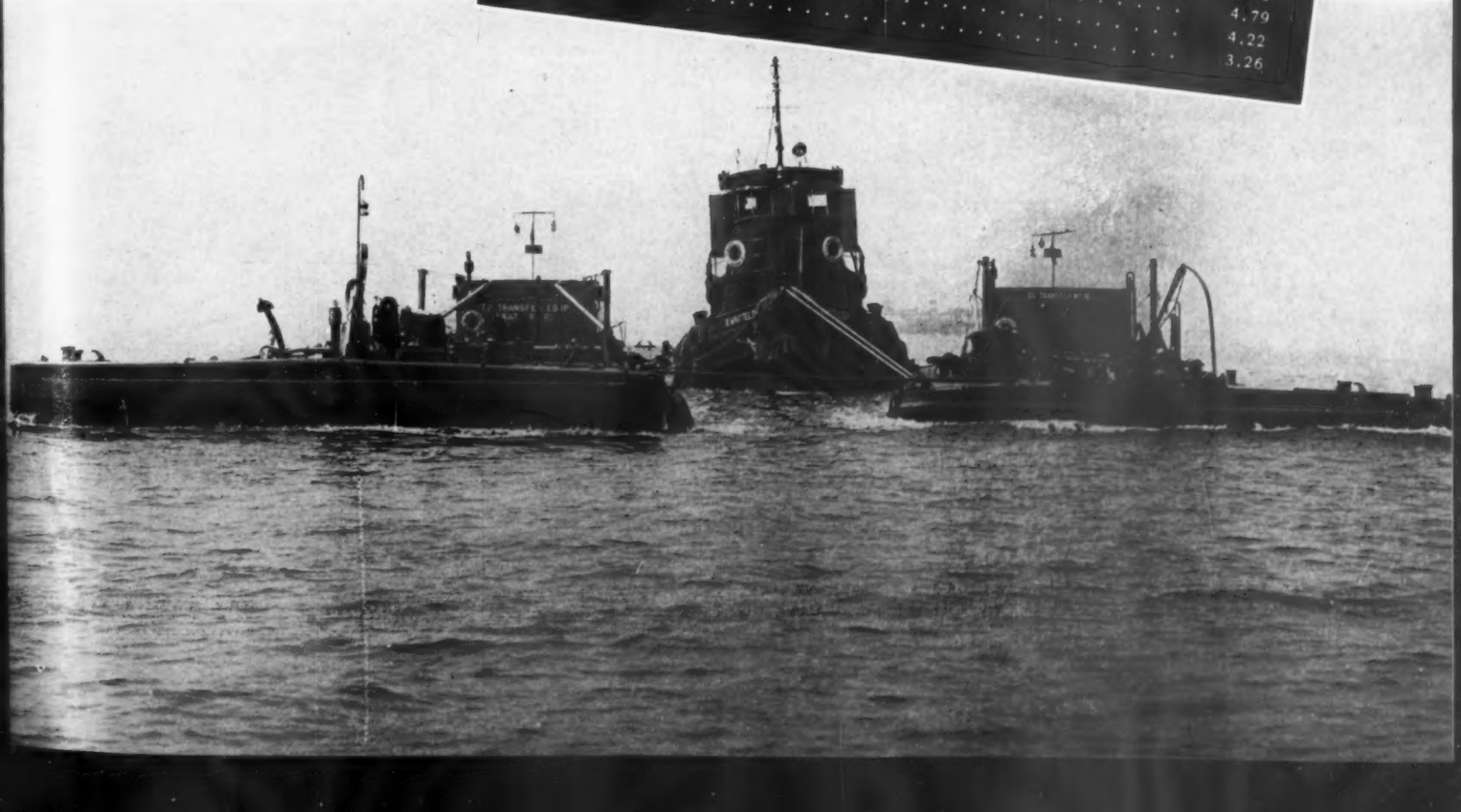
This situation, as well as other factors, such as rationing, increased taxes, higher operating costs, has been reflected in second quarter profits of oil companies. The initial three months of this year, in contrast, gleaned the benefit of higher product prices as compared with a year ago, with the result that profits in that period were substantially ahead of the similar quarter in 1941.

For the first six months of this year net profits of 32 companies showed a reduction of slightly more than 20 percent, after all charges, including taxes, against the similar period in 1941. The first quarter profits in this year, in contrast, were 25 percent higher than in the corresponding three months of 1941.

AVERAGE RATE OF RETURN ON STOCKHOLDERS BOOK EQUITY OF CORPORATIONS LISTED WITH S E C

For the Years 1935 - 1939

		Percent
1.	Beverage, Brewing & Distilling	17.21
2.	Tobacco Products	12.56
3.	Chemical & Allied Products	12.22
4.	Transportation Equipment	11.28
5.	Chain Stores	11.07
6.	Machinery & Tools	9.60
7.	Miscellaneous Manufacturing	9.57
8.	Merchandising	9.33
9.	Manufacturing	7.90
10.	Non-Ferrous Metals	7.72
11.	Printing & Publishing	7.60
12.	Food & Food Products	7.39
13.	Tires & Rubber Products	6.96
14.	Leather & Leather Products	6.41
15.	Building Material & Equipment	6.38
16.	PETROELUM REFINING	6.26
17.	Textiles & Textile Products	5.81
18.	Department Stores	5.63
19.	Lumber & Lumber Products	5.62
20.	Financial	5.53
21.	Paper & Paper Products	5.45
22.	Electric Light, Power, Heat, Gas	4.79
23.	Extractive Industries	4.22
24.	Iron & Steel	3.26



Below: Tug with oil barge tow working in Long Island Sound.

WORK FOR VICTORY—PREPARE FOR PEACE

By Paul Ryan

Petroleum Economist, Former President
National Refining Company

Problems and Opportunities Arising From the War Call for Careful Study and Wise Action by Petroleum Industry in Preparation for the Post War Period

ON December 4, 1940, an airplane en route to Chicago with sixteen persons aboard crashed near that city. Out of the twisted wreckage of thirteen tons of steel, rescuers dragged ten bodies from which life had departed and six others more or less seriously mangled. One of the latter was Paul Ryan, president of The National Refining Company, whose body had been literally pulverized. The list of his injuries as compiled later comprised two hundred fractures, dislocations and lacerations, not to mention internal injuries regarded as mortal. According to medical records no human being so ground up ever before had remained alive. Paul Ryan did not die. He fought his way back to life inch by inch in the face of overwhelming odds and today according to his statement "I have all my parts back where they belong except for a permanently dislocated hip" and with scarcely a scar to show the ordeal through which he had passed.

Through months of enforced inactivity Mr. Ryan has been a close observer of contemporary events and has continued the studies of the economic problems of the petroleum industry which had brought him to an outstanding position before his terrible accident. From the vantage point of his detached position he has developed many constructive ideas regarding present problems of the petroleum industry which have an important bearing on its future. These are presented in the following important article which deserves the careful study of all those connected with the management of petroleum properties.—Editor.

OUR PRIMARY TASK—the most important job of all Americans—is to use all our energies and direct all our activities toward winning this war decisively, quickly and completely. No consideration should be allowed to interfere with our wholehearted and enthusiastic achievement of complete victory. One of the most important aspects of our participation in this war has been the total all-out voluntary cooperation of all Americans; all the people—the householders, the factory workers, the white-collar masses, the executives, the bankers—all, except some of the politicians, the office-holders and the bureaucrats, have willingly offered themselves and their possessions in an unselfish devotion and inspiring cooperation which undoubtedly is most discouraging to our totalitarian enemies. Governments, not individuals, wage wars. The government, during war-time, must necessarily appropriate, for the benefit of the community, all personnel, products, property and privileges to wage a common fight for the common good. It must be remembered, however, that although governments wage wars, private industry and individuals must carry the burdens of the remnants of their lives, uncontrolled by war, and, in the post-war period, must resume the full burdens of peace. Private industry, therefore, has the dual responsibility of devoting all its energies possible toward the production of means to end this war quickly and victoriously, and yet it also must retain its essence and its substance so that, when the war ends, as all wars do end, the opportunities for progress and development of individual initiative will be adequately provided by private industry.

There are perhaps, many things which an oil company should do, during these troublous times, to operate more efficiently during these days when highest efficiency is highest patriotism, to perpetuate its own existence now and to guarantee a continued existence in the post-war period. Mature analysis indicates three procedures which each oil company should well consider adopting in these times: (1) Cut costs of operation, particularly marketing costs. (2) Intensify research to develop new products for the war, and for the post-war period. (3) Create a favorable public attitude toward the company, and toward the industry as a whole. The first of these, Joseph H. Spigelman well emphasizes in his article "The Tyranny of Incompetence" in Harper's magazine for May, 1942. These war operations are having an adverse effect on industry for two reasons: first, the emphasis is piled on "speed of production" regardless of cost; second, the tax bill, which takes 90 percent of excess profits, causes an unwise management to indulge in unnecessary expenditures on the theory that such expenses are coming out of funds that otherwise would be paid in taxes, and that, therefore, the company is really only paying 10 cents and the government is paying 90 cents on each dollar of such expenses. Spigelman properly concludes that the result of these two factors will cause such a "Tyranny of Incompetence" among executives of private industry that they will demand in the post-war period, the continuation of those conditions which would make such incompetence an essential ingredient of business operation.

Every oil company should vigorously reduce expenses to the minimum necessary for intelligent operation and should ruthlessly eliminate costly inefficiencies, not only to perform a better job in war time, but also to enable the company to maintain its existence in the post-war period. In all departments, such cost-reduction is not only possible but necessary—in production, transportation, refining, and particularly in marketing.

The oil industry has done the most remarkable job in industrial history in making its petroleum products immediately accessible, through its distributing facilities, to any motorist, no matter where he lives; no other industry can begin to compare with this outstanding service performed by the oil industry. But in the industry's great desire to provide satisfactory service facilities, there have resulted a rapid multiplication and a costly duplication of distributing facilities between companies, and even between the facilities of the same company.

Every student of the industry recognized that inevitably there was coming a "day of reckoning"; the war has brought that day of reckoning right here at hand. The wise managements of progressive oil companies now are welcoming this opportunity to clean up this costly inefficient situation, which, as a cancerous growth, was eating at the very vitals of profits for the oil companies. Before the war, there were approximately 400,000 retail outlets for gasoline and oil in this country; the average gallonage per outlet was approximately 3,000 gallons per month—a fraction of the actual gallonage needed by a dealer adequately to represent a progressive oil company. In the same number of years, in which the number of automobiles has tripled, and each car has doubled its annual consumption of gasoline, making a six-fold increase in the demand, the service facilities to supply this six-fold demand have increased twenty-two times. Obviously, much of the $4,000,000,000 invested in marketing facilities was wasted through such costly duplications.

"Mileage rationing" doubtless will reduce consumer gasoline sales nationally approximately as it did in the East; rubber shortages are reducing further consumption; stations are closing because dealers are leaving for jobs in war plants or for

service in the army, reduced gallonage and the elimination of dealers' rent at the open stations are making retail marketing costs rise precipitately. Now is the logical time for each oil company carefully and meticulously to study the profitability of each of its retail consumer operations, and to eliminate, first, those stations which before the war were unprofitable or were "marginal operations," second, those stations which, since the war, have become highly unprofitable and will remain unprofitable, for the duration and after.

"The day of reckoning" is here. Let the industry welcome this long-delayed, but inevitable and necessary, day by closing forever those service stations which have been, and are now still, unprofitable and costly to service. Let the companies close the oldest stations and patriotically sell for needed scrap the oldest pumps, tanks and equipment, thereby benefitting the companies' operations, their stockholders, the motoring public, the industry, and their country in time of need. Let the industry resolve to emerge from this war with its own distributing system geared to make a profit on every station, by eliminating every company-owned and dealer's station which operates at a loss and drains the profits of the company. Profits now and hereafter will be too hard to obtain to waste them deliberately on "losing" stations. Gallonage hereafter must be retained only if it is labeled "Gallonage—with profits".

Following this article is a photograph of a service station on Carnegie Avenue, Cleveland. It formerly was operated by the Shell Oil Company. It duplicated a Cities Service station across the street. The wise management of the Shell Oil Company, recognizing that this station had become permanently unprofitable, abandoned the location. The sign reads:

"For Rent or Lease

Available for Florist, Barbecue or other Purposes, Plenty of Parking Space, See A. D. Fraser, Inc."

I wonder if there is anything singular between the name of the real estate agent A. D. Fraser, and the name of that good friend and admirable executive, Mr. Alexander Fraser, President of the Shell Oil Company. I hope that the example set by these Messrs. Fraser will be imitated widely and frequently by the other executives in the oil industry.

In an article written by me in the December 1937 issue of WORLD PETROLEUM, the companies' own annual reports, and other data, showed that while the pipeline division and the production division of the oil companies made profits equalling 206 percent of the final net profits of the company, the refining and marketing divisions lost an amount equal to 106 percent of these net profits. In other words, if the refining and marketing divisions could "break even" the net profit of the industry would more than double.

Herewith are presented a table and chart showing eighteen selected companies, comparing their 1936 operating results (expenses and net profits) with their 1941 results, in terms of their total sales. These data, relating to the operations of the eighteen leading oil companies for the years 1936 and 1941, suggest the following interesting comments:

1) The average increase in sales from 1936 to 1941 was 31.4 percent; the "ratio of operating expenses to sales" declined, on the average, from 75.5 percent to 70.9 percent; the "ratio of net profits to sales" increased from 9.6 percent to 10.1 percent. This picture reflects healthy, intelligent, progressive operations.

2) A reduction of one percent in operating expenses (cost of sales, selling, general, and administrative expenses) increases net profits by 10 percent, or more, in each year; three cents saved out of each dollar of operating expenses would increase net profits 30 percent.

3) Some companies—Standard of New Jersey, Atlantic Refining, Tidewater Associated, Pure Oil, Continental, and Cities Service—materially increased their "ratio of net profits to sales"; each one of these companies simultaneously achieved substantial reduction in its "ratio of expenses to sales."

4) Some companies—Gulf, Sun, Standard of Ohio—increased their sales beyond the average for the group, but since their "expense ratios" were not adequately reduced, their "net profits ratios" made but slight increases or declined; Standard of Ohio, as we shall see later, suffered severe slashing of its profits by federal income taxation.

5) Standard of New Jersey's decline in foreign business reduced its total sales volume, but apparently it materially aided its profit position. With 16 percent less business, Standard of New Jersey reduced its actual dollars of expenses almost 28 percent and increased its ratio of "net profits to sales" by over 71 percent. This unusual achievement could well set a guiding precedent for other companies on domestic business as well.

6) Pure Oil increased its sales volume only six percent in the five-year period; except Standard of New Jersey, this was the smallest increase of any company. Pure, however, added 100 percent to its actual dollars of profits, by reducing its actual expenses 7.4 percent, while increasing its sales six percent. This example of excellent management well illustrates the increases in profits obtainable solely by reducing expenses.

7) Ohio Oil in 1941 produced the smallest volume of sales of all 18 companies. In both 1936 and 1941 it achieved the lowest of all 18 "ratios of expenses to sales." In 1941 it reduced its expenses to the phenomenally low percentage of 58.5, and simultaneously achieved the highest profit ratio of all 18 companies—15.9 percent, proving the inevitable relationship between low costs and high profits.

8) Companies such as Texas, Standard of California, Phillips, Pure Oil, Continental, and Ohio Oil, who are either net sellers of crude oil, or who supply almost all their own refinery requirements from their own production, in general have operating ratios of 65 percent, whereas other companies, lacking such a favorable crude position, have operating ratios of over 75 percent. Similarly the profit ratios of companies having ample crude facilities average 14 percent, while the other companies, not so fortunate, have average profit ratios of 8 percent. Owning the raw material in any industry, particularly in these times of mounting costs, helps to reduce operating expenses and to increase net profits.

9) Taxation by federal income taxes proved heavy for all companies, but particularly so for Standard of Ohio, which made exemplary rapid progress in these five years, and yet suffered so heavily through taxation that its case warrants special comment.

In the second chart, companies are arranged in the descending order of "The Percentage of Federal Income Taxes to Net Profits." Notice that:

a) 17 of the 18 companies paid federal income taxes, on the average, equalling 24 percent of their profits before taxes; while Standard of Ohio paid 54 per cent.

b) Very few companies paid any excess profits taxes; only four companies specified and identified any excess profits tax payments. Standard of Ohio paid more actual dollars as excess profits taxes than the other three companies combined—an amount equal to 34 percent of Sohio's total profits, before taxes.

c) 17 companies paid average federal income taxes equal to 35.7 percent of their final net profits (after taxes); Standard of Ohio paid federal income taxes equal to 118 percent of its final net profits.

d) The lower percentages of taxes to profits were achieved by several companies which normally produce the larger share of their own needs for crude oil.

e) Standard of Ohio offers an outstanding example of the punishing effect of federal taxation on corporate initiative.

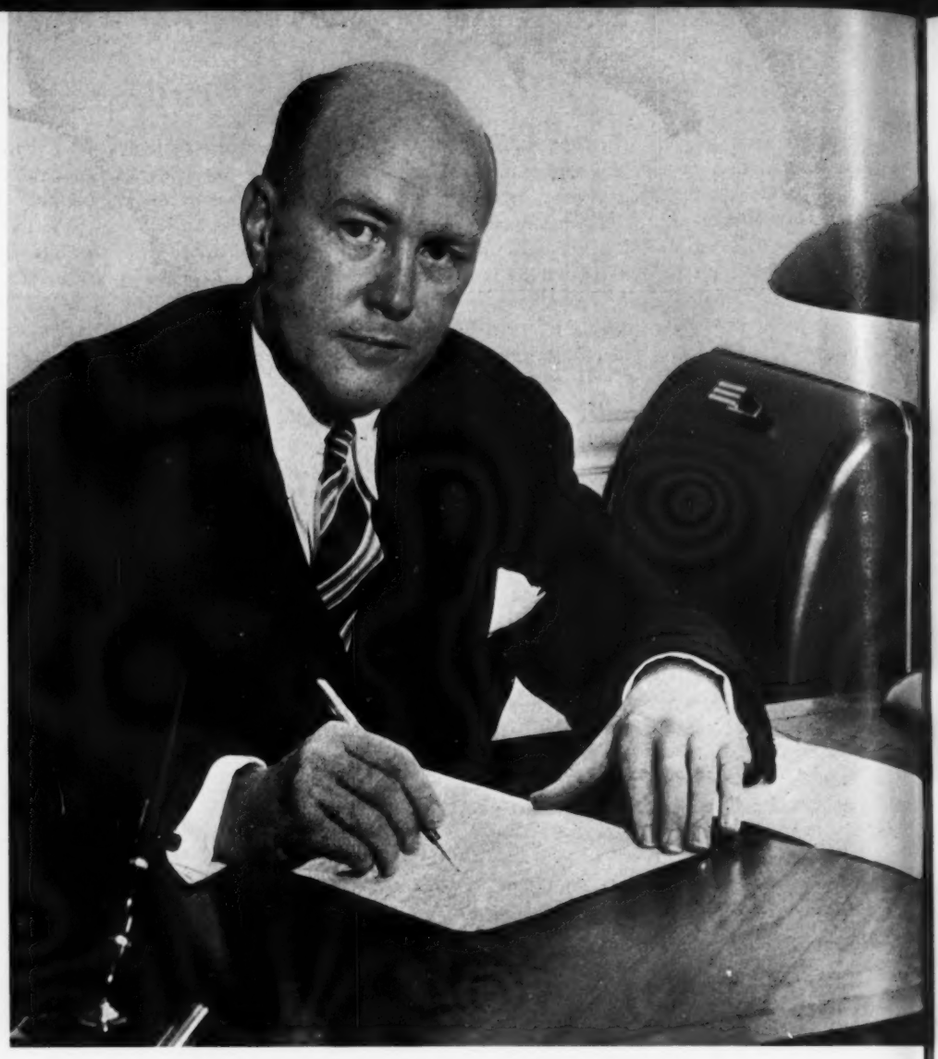
Let us realize also that these burdensome taxes were paid for the year 1941—before we entered the war. The 1942 tax bill of the oil industry will be greatly increased.

These data show that oil company managements have followed the same procedures in these years as well-managed companies in other industries; i.e., they have reduced their expenses in relation to their total sales, and have tried to achieve modest profits which could contribute toward the assurance of continuous employment for their employees and some dividends for their owners, the stockholders. Further reductions now by the oil companies' managements are wise and desirable. Scrupulous examination of all expenses

will make the reduction of some expenses easier now by voluntary action, rather than later when smaller net profits, because of heavier taxation, will increase the pressure for such necessary and unpopular reductions. Such voluntary, intensive reduction of expenses will serve also to prevent the adoption of any threatened government activity. The recent proposed edict of one governmental branch that it might assume some measure of control over the marketing operations of the oil industry, so as to close the vast majority of service stations and use only one centrally located station as a distribution center for an entire area, demonstrates most clearly the governmental determination to stop waste and inefficiency. The oil industry should not only resist the compulsion from without by those who are not familiar with the industry's conditions, but with equal strength and courage, the industry should resolve to close its own unprofitable and duplicating stations voluntarily, of its own free will and accord, so as to demonstrate the industry's desire to stop waste and inefficiency in any form. The proper maintenance of public confidence in the oil industry should strongly urge the industry to take those steps voluntarily which it deems necessary to effect more efficient distribution, and thereby obviate the need for any governmental authority to use compulsion to achieve the same ends. This imminent development of governmental compulsion is one of the strongest arguments why each oil company should aggressively pursue an intensive policy of reducing its expenses.

In the April 1939 issue of WORLD PETROLEUM, we asked, "Will the Companies Eliminate Marketing Losses—Before the Government Does?" From the companies' own reports to the Securities and Exchange Commission, we analyzed the profits by each operating division—production, transportation, refining and marketing — and showed that many companies could have greatly increased their net profits, if they had made their refining and marketing operations "break even." For a tabulation, we selected five companies of varying sizes, (annual business from $100,000,000 to $400,000,000), and pointed out that while three companies made net profits in all divisions, especially refining and marketing, a fourth company could have increased its net profits by 30 percent, and a fifth company by 44 percent, if its refining and marketing divisions could have stopped their losses.

In that article, we made detailed recommendations regarding the correction of those losses and the gaining of profits. As an exemplification of the application of these recommendations, which were based upon years of actual experience by many executives in the oil industry, The National Refining Company, the smallest integrated company in the petroleum industry, utilized these procedures to its very great benefit, during the years 1939 to 1941, and has continued them unchanged ever since. National inaugurated individual profit-and-loss statements for each major operating department; it further made a separate



Paul Ryan, former President of the National Refining Company and noted petroleum economist presents in this article a careful study of the problems facing the petroleum industry.

profit-and-loss statement on each producing lease, each pipe line operation, each refinery unit, and on each sales division, salesman's territory, bulk plant and service station. Armed with these facts, the company abandoned or sold unprofitable production leases, and obtained new ones—abandoned old pipe lines with high operating costs, and built new economical bigger pipe lines —modernized refinery equipment—and closed, or sold to competitors, the unprofitable bulk plants and service stations, thus stopping repetitive losses and bringing additional cash into the company treasury.

As a result, National reduced the number of division offices from twelve to six, reduced sales territories and eliminated the unproductive sales personnel. With 20 percent less men, with materially reduced numbers of bulk plants and service stations, the company did 50 percent more business, and turned years of losses into profits by cutting overhead in great measure and increasing only the profitable business. From 1938 to 1941, dollar sales increased 50.5 percent; operating expenses were reduced from 99.5 percent to 88.1 percent of total sales, and profits, on a comparable basis (excluding capital gain or loss on sale of properties), changed from a loss equal to 3.5 percent of sales to a profit equal to 4.4 percent of sales. In other words, conforming to the general trend among the larger oil companies, National increased its sales, but reduced its expenses in relation to its total sales. The application of these recommended procedures has made The National Refining Company profitable, and it has remained, ever since, more profitable than at any time in its last dozen years.

National is merely one of several companies whose recent activities illustrate the beneficial effects of aggressive cost-reduction upon the operations and profits of a company. If the smallest integrated company in the entire petroleum industry, with its limited resources and its lack of adequate concentration in profitable markets can change every department of its operations, particularly its marketing, from losses into profits, even during periods of the lowest prices in the history of the industry, certainly much larger companies, having vastly greater resources, more flexibility, and obtaining greater revenue per gallon, can readily do so, by the application of cost-reducing methods, so as to make the operations sounder and more efficient now—and for the post-war period. Details of procedure will differ but the principle is applicable by all.

We next recommend that the oil industry intensify its research to make new products, to substitute for those which are not obtainable during the war period and to provide products which may do a better job in the post-war period. War has always stimulated inventive genius. The urge to do things better, more quickly for self-preservation during war-time, develops genius; the brevity of time for a problem's solution stimulates daring and initiative; it puts pressure on inventive genius to produce progress for mankind—progress, initially to destroy mankind, but by later adaptations of this same inventive genius, to benefit mankind. Every recent war, waged to kill man, has later improved man's standard of living. From our war-needs have grown, within the present lifetime of some individuals, whole industries built on inventions of telegraphy, electricity, radio, automobiles, airplanes, chemicals, and so forth. The urgent war-uses produce new products; new products are adapted to peace-time betterments.

This recommendation to the oil industry to develop new products involves a dominant element of "self-preservation" in the post-war period. The cost of the present war, and the previous governmental spending, have now created an indebtedness of over $200,000,000,000, an average of $1500 for every man, woman and child in this country. The transcendent need for increased taxes to maintain the solvency of the government and pay this colossal debt, after the war, will successfully prevent gasoline, lubricants and fuel oil from slipping out from under the regulatory and taxing eye of the government; these petroleum products, so necessary to the existence of the masses of people, form a most attractive vehicle on which increasing burdens of taxes and regulations will undoubtedly be heaped. Therefore, it well behooves the companies in the oil industry to intensify their research, to increase developments of new products for the consumer and for industry, on which reasonable profits may be made; the government may continue to remain somewhat unfamiliar with the variety of these chemical products and would obtain its revenue from these operations only by its all-inclusive income taxes, affecting all industries.

When the revenue from their main products was curtailed or eliminated after the last war, many companies, in various industries, turned to the manufacture of chemicals and chemical compounds. By so doing they not only have performed a tremendous service to the country but have received very satisfactory profits. The oil industry is very fortunate in that it can continue to use gasoline, fuel oils and lubricants to pay its costs of operation, but inevitably, in the future, its profits will need to come from its development

TABLE I

COMPARISON OF SALES, OPERATING EXPENSES AND NET PROFITS
for
18 LEADING OIL COMPANIES: 1936-1941

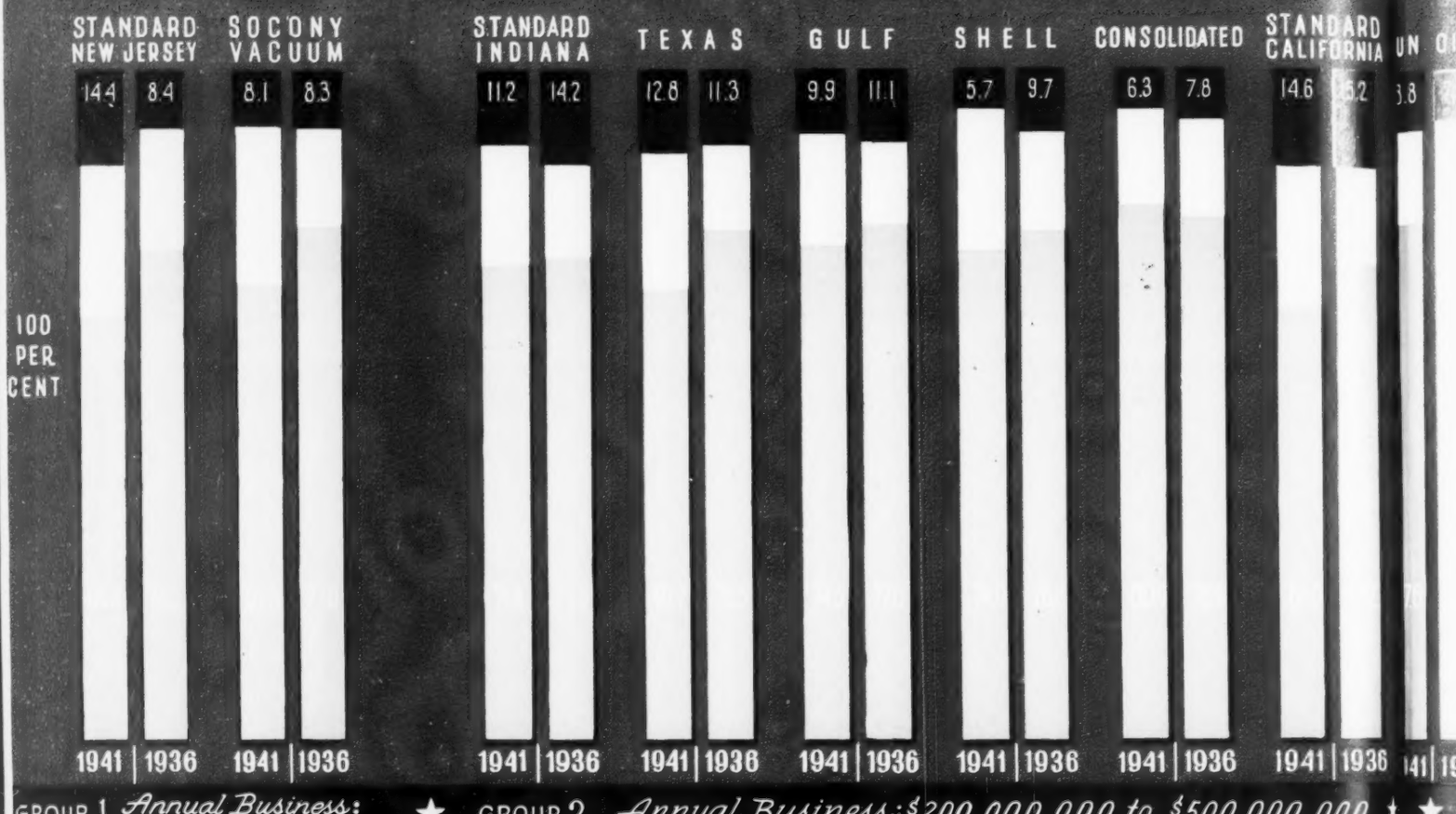
Company	Sales 1941 ($1,000,000)	Sales 1936 ($1,000,000)	Sales Increase 1941 vs. 1936 (%)	Operating Expenses 1941 ($1,000,000)	Operating Expenses 1936 ($1,000,000)	Ratio Expenses to Sales 1941 (%)	Ratio Expenses to Sales 1936 (%)	Net Profits 1941 ($1,000,000)	Net Profits 1936 ($1,000,000)	Ratio Net Profits to Sales 1941 (%)	Ratio Net Profits to Sales 1936 (%)
I Annual Business of $500,000,000 up											
1. Standard-New Jersey	978.4	1162.2	(15.8)	624.7	861.6	63.8	74.0	140.6	97.8	14.4	8.4
2. Socony-Vacuum	535.1	518.6	3.2	362.3	399.3	67.6	77.0	43.2	42.9	8.1	8.3
II Annual Business of $200,000,000 to $500,000,000											
3. Standard - Indiana	427.2	331.0	29.0	306.1	241.8	71.5	72.8	48.4	46.9	11.2	14.2
4. Texas	405.3	337.5	20.5	275.0	258.2	67.7	76.5	51.9	38.3	12.8	11.3
5. Gulf	337.8	238.5	43.3	251.8	182.9	74.5	77.5	33.6	26.3	9.9	11.1
6. Shell	300.0	231.7	29.5	222.5	177.5	74.0	76.6	17.3	22.5	5.7	9.7
7. Consolidated	258.8	215.4	20.2	207.8	169.1	80.0	78.6	16.5	16.7	6.3	7.8
8. Standard-California	205.0	153.2	33.8	133.4	109.2	65.0	71.2	29.9	23.3	14.6	15.2
III Annual Business of $50,000,000 to $200,000,000											
9. Sun Oil	187.9	105.4	78.2	145.6	83.3	77.6	78.8	16.5	7.6	8.8	7.2
10. Atlantic Refining	161.1	113.1	42.4	117.7	90.2	73.0	79.7	14.3	7.3	8.9	6.4
11. Tidewater Assoc.	148.7	124.5	19.4	107.9	93.6	72.6	75.3	12.8	6.8	8.6	5.5
12. Phillips	142.4	105.1	35.4	93.0	66.6	65.3	63.4	17.4	17.8	12.2	16.9
13. Pure Oil	112.9	106.1	6.4	79.5	85.8	70.5	80.6	15.3	7.7	13.6	7.3
14. Standard Ohio	111.1	51.4	116.0	92.2	44.4	82.9	86.3	6.3	4.2	5.7	8.2
15. Continental	106.5	75.8	40.5	69.2	53.4	65.0	70.5	15.4	9.6	14.4	12.7
16. Union Oil	79.6	67.6	17.7	60.1	51.8	75.5	76.5	6.2	6.1	7.8	9.0
17. Cities Service	73.0	60.9	19.9	53.3	51.8	73.0	85.0	1.6	(0.3)	2.6	(0.5)
18. Ohio Oil	68.0	53.0	28.3	39.8	32.4	58.5	61.0	10.8	7.9	15.9	14.9
			31.4			70.9	75.5			10.1	9.6

( ) means deficit

STUDY OF 18 LEADING OIL COMPANIES

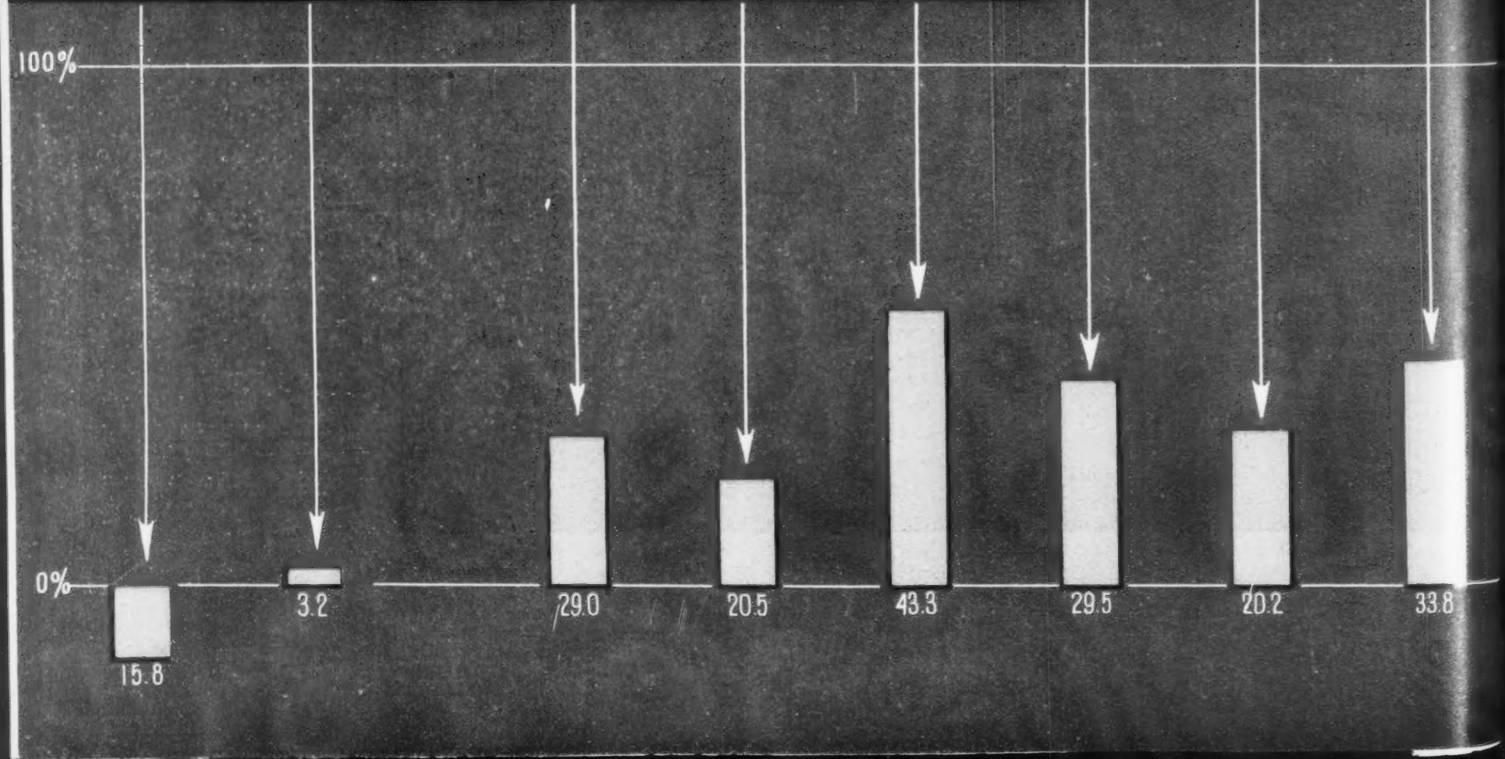
CHART 1. *Comparison of Sales, Operating Expenses and Net Profits*

By PAUL RYAN

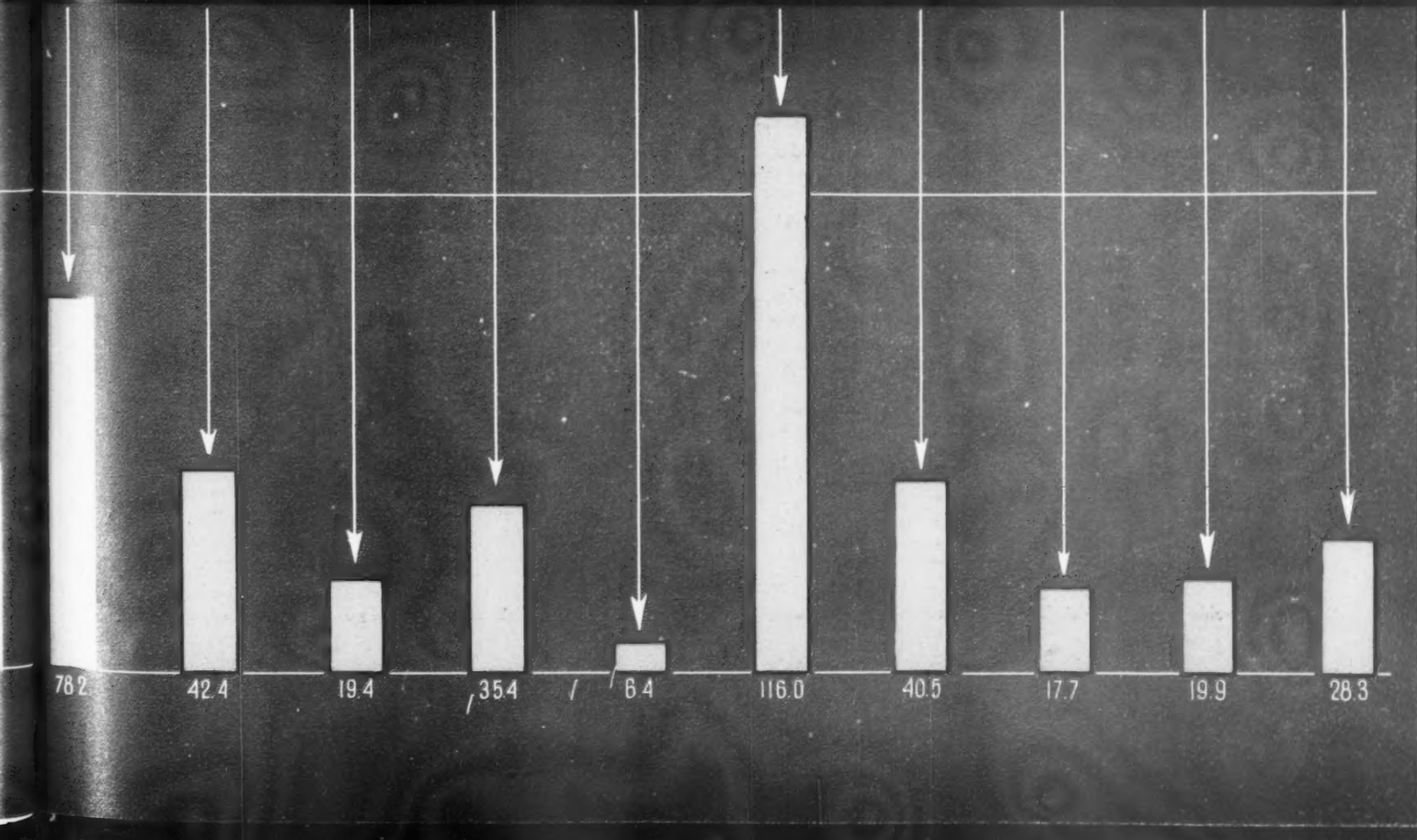


GROUP 1. *Annual Business: $500,000,000 and up* ★ GROUP 2. *Annual Business: $200,000,000 to $500,000,000* ★ ★

CHART 2. *Percentage Increase in Sales 1941 over 1936*



GROUP 3. *Annual Business: $50,000,000 to $200,000,000*



of chemical products for the consumer and for industry, by using its power of modern magic on a barrel of crude oil.

The inventive genius of the personnel of the oil industry has developed 100 octane gasoline, synthetic rubber, plastics, films, explosives and many other products, all of which will help win the war, and, after the war, will make life more worth-while.

A barrel of oil contains so much of value that from it can be made thousands of products having a combined value several thousand times the value of the usual fuels and lubricants. The oil industry has the ability, the resources, the scientific facilities and the executive initiative to develop these products and market them profitably. Why should the oil industry pioneer through the early days of the development of these products, and then turn their later development, manufacture, marketing and profits over to other industries?

Other industries are turning their thoughts to post-war adaptations of war-time products—witness current advertisements creating post-war consumer demand; other industries are definitely planning to invade post-war consumer markets with new products — witness the emphasis on alcohol from agricultural products as a source of butadiene for synthetic rubber. Now is the time for the oil industry not only to develop methods of manufacture of these new products for war-time uses, but to follow the wise recommendation of the National Association of Manufacturers and create plans to adapt these products to the needs of the consumer and of industry, recognizing that, while manufacture is important, the continued success of the operation depends upon creating an adequate "consumer demand" for this particular product (or brand of products) which will assure the products being marketed at a profit.

Recently, when I was enthusiastically discussing the development of these synthetic products and the absolute necessity for the oil industry to use them so as to be independent of future additional Governmental regulations, Mr. Warren C. Platt, reminded me of the fact that almost fifteen years ago, in the winter of 1928, I had written a series of three articles for his publication, "National Petroleum News," under the heading, "Natural Gasoline Industry Must Make New Products, Find New Markets," in which I stated, in part:

"We are now, for the first time in our modern history, faced with the problems of finding for ourselves profitable markets. * * * We must decide whether we are to continue to make one or two products—fuels and lubricants—or whether we are to turn to the fullest advantage the raw material we have at our command and convert it into other industrial products.

"We must decide whether we shall convert our petroleum into fuel—the least profitable product—or whether we shall develop, from our petroleum, chemical compounds—which are most profitable.

"It is rather an empty boast for our industry, colossal as it is, to take pride in the fact that we make only fuels and lubricants out of such a rich raw material as we possess. No other industry, equally large, makes so few products; pride and common sense and vigilance for the future compel them to diversify their products and make profits where possible. Scientists and economists, years hence, will demand that we be exhumed and punished for our criminal waste.

"Until now our marketing research has been devoted to finding a territory where we could undersell our competitors with our cheapest products—always destructive; we should now devote our time and energy to something constructive—serving industrial markets already developed with products which we can profitably make and developing new industrial outlets for other products which we can profitably make."

After reciting complete costs for utilizing stabilized natural gasoline and butane for the various physical and chemical uses outlined in the articles, the articles continue:

"Butyl alcohol, now made by the fermentation of corn, is used as the original base from which are made hundreds of chemical compounds, having myriad uses. Butyl alcohol, known in the trade as "Butanol," has the following principal uses: (1) Solvent—paint and varnish remover; (2) Solvent—explosives, artificial silk, collodion plastics, celluloid, etc.; (3) Extractor — alkaloids, liniments, pharmaceuticals; (4) Film — motion picture, photographic, non-shatterable glass, etc.; (5) Lacquers—spray and brush, dip and flow, etc.; (6) Dopes—patent leather, artificial leather.

"Butyl alcohol can be treated by chemical processes to produce: (1) Chemical compounds of the butyl radicle group, e. g., butyl acetate, butyl butyrate, dibutyl tartrate, etc.; (2) Perfumes. alcohols, and ethers; (3) Flavors and extracts; (4) Dyes; (5) Pharmaceuticals; (6) Plastics, films, artificial silks, lacquers, and leather dopes.

"All of these products are now being profitably made from butyl alcohol. * * * The output of some companies, manufacturing butyl alcohol, has trebled within the past three years—and the end is not in sight. * * *

"In the meantime, let us continue to use brains, ingenuity, and hard work, and devise every means in our power to carry forward the great engineering triumphs of our industry, and make the fullest use of the raw material which a beneficent Providence has given us, so that this petroleum industry of ours will be not only great, but great—and profitable."

The expression of these thoughts created such enthusiasm in Mr. Frederick Godber, then President of Roxana Petroleum Corporation and now one of the directors of the whole Royal Dutch Shell group, and his reception to these ideas was so energetic, that we inaugurated the "Technical Products Department" at Shell, which, through the years, the scientific minds and the research marvels of the Shell Company, have brought to fruition in what Shell popularly calls its "Petroleum University," which, with wondrous alchemy, develops products to win the war, benefit consumers and to make industry more efficient in a multitude of ways.

Other large companies in recent years, have also done outstanding work in developing technical processes for the manufacture of chemical products. What the oil industry needs, most of all, however, is not merely the scientific brains in a few companies to make these new and fascinating products, but a widespread appreciation of the need for all oil companies possible to utilize to the fullest the tremendous opportunity, in the post-war period, to convert their magic raw material, petroleum, into myriad chemical compounds to open new and better vistas of service for consumers and for industry and, thereby, assure continuous and reasonable profits for themselves.

Our third recommended procedure relates to the necessity for creating a favorable public attitude toward the petroleum industry.

Let those who doubt the existence of an unfavorable public attitude toward the petroleum industry created by the rubber situation, and other unfortunate occurrences, talk to some business men in other industries, or to some typical representatives of the general public. The doubters will rapidly learn that this perpetually human propensity of blaming somebody else when something goes wrong, has caused the general public, who are the customers and the life-blood of the petroleum industry, to follow the lead of the politicians and again blame the petroleum industry.

It is unfortunate that such a situation exists, that the petroleum industry, slaving night and day, not only in its own industry but in other industries, to develop unheard-of volumes of undreamed-of products, and participating in the war effort to a greater extent than almost any other industry, should be so maligned by the politicians, and so misunderstood by the general public. No matter where the fault lies, the cure lies solely in the hands of the executives of the companies in the petroleum industry. They must do it themselves; no one else is going to do the job for them.

This war has been styled "The People's War." That accidental nomenclature is more truthful than many of us realize. This war has stirred the emotions of masses of people who before had never been moved; those people now are restless,

vocal and active. Public opinion, composed of the mass opinions of the common man, will carry much greater weight in the future than it has in the past, politically, economically and industrially. That great group of silent voices has now been given the opportunity to become vocal; they will not quickly, if ever, become silent again.

The wisest heads of industry have realized that this newly-developed powerful mass of people will think something and have some ideas on whatever matters they contact; further, they will express these ideas and act on them. Therefore, these wise executives are trying to shape the public's thoughts, to help the public to understand industry's problems, and get the public to appreciate the beneficial services which these companies are rendering the public. The wise executives are shaping the public's opinion of their companies in a mold distinctly favorable; the unwise executives are maintaining a dignified aloofness; they let the public find out what it wants, if it wants to, and believe that the attitude of the public is "none of my business," just as what the company does is "none of the public's business."

The fallacy in the reasoning of the unwise executive is that somebody makes it his business to make sure that what he wants the public to believe about a company or an industry, becomes "the public's business." And usually, what the public has been led to believe by some self-seeking politician is not beneficial to the company or the industry; several oil companies can bear testimony to the effects on their fortunes by directed public opinion, for the beliefs, opinions and actions of the public will build or destroy a company or an industry. We have witnessed that occurrence in the past; we shall witness it more forcefully in the future with this new-found power of the people. Somebody will mold public thinking; each executive should make the public think favorably about his company and his industry.

Some suggestions are listed here which represent the composite thinking of executives in the petroleum industry and in other industries, all of whom are interested in public relations. These men suggest that each major petroleum company should take definite action to:

(1). Provide assistance for its government and its country by cooperating with every other oil company to make and deliver the products needed for our armed forces and for industry, quickly, successfully and economically in time and money.

(2). Imitate the automotive and aviation industries, by exchanging, with each other, all necessary information, engineering processes and data, tools, equipment, supplies, and even personnel. These erstwhile antagonists, to achieve victory for America, now have submerged their competitive activities, and produced admirable harmony and unity. Their actions have won wide public approval, for unity is not only patriotic today, but absolutely necessary for our existence. Much of this type of cooperation has been achieved between some companies in the oil industry, but much more needs to be done to rival the cooperation within the automotive and aviation industries.

(3). Dramatize, for the public, real "news-stories" showing how the oil companies are cooperating with each other, and with the government. The advertisements of Consolidated Aircraft and General Motors are noteworthy; each company builds itself, in public opinion, by emphasizing the cooperation, for victory's sake, between it and its various competitors.

(4). Associate the company with the war program; the public's great existing interest in war matters will extend to, and benefit, the company. Use plain, understandable language, plenty of pictures and media which permit personal follow-up by dealers, salesmen, etc., supported by "newsworthy" publicity releases in publications. Make the material so interesting, it makes the public want to read it.

(5). Help jobbers and dealers, whose business is adversely affected by war, to adjust themselves, particularly those whose stations must be closed. These men have friends; make them all friends of the oil industry.

(6). Adjust differences with the Attorney General's office, so as to remove any further misunderstandings, during war time. Be magnanimous; set an example of patriotic generosity. Let the industry say "We are sorry!", if that is necessary to wipe away past animosities, so the members of the oil industry can freely collaborate not only between themselves but with the government, without the threats of governmental action so damaging to the public's opinion of an industry. (Passing comment must be made of the example set by the cooperation between Mr. Ickes and the petroleum industry; this result has been achieved by generous attempts, by both parties to understand and cooperate with each other. A most interesting counterpart of "The Education of Henry Adams" would be "The Education of Harold Ickes and Oil Executives.")

(7). Meet frequently with fellow-members of the industry; assuage the fears of the governmen-

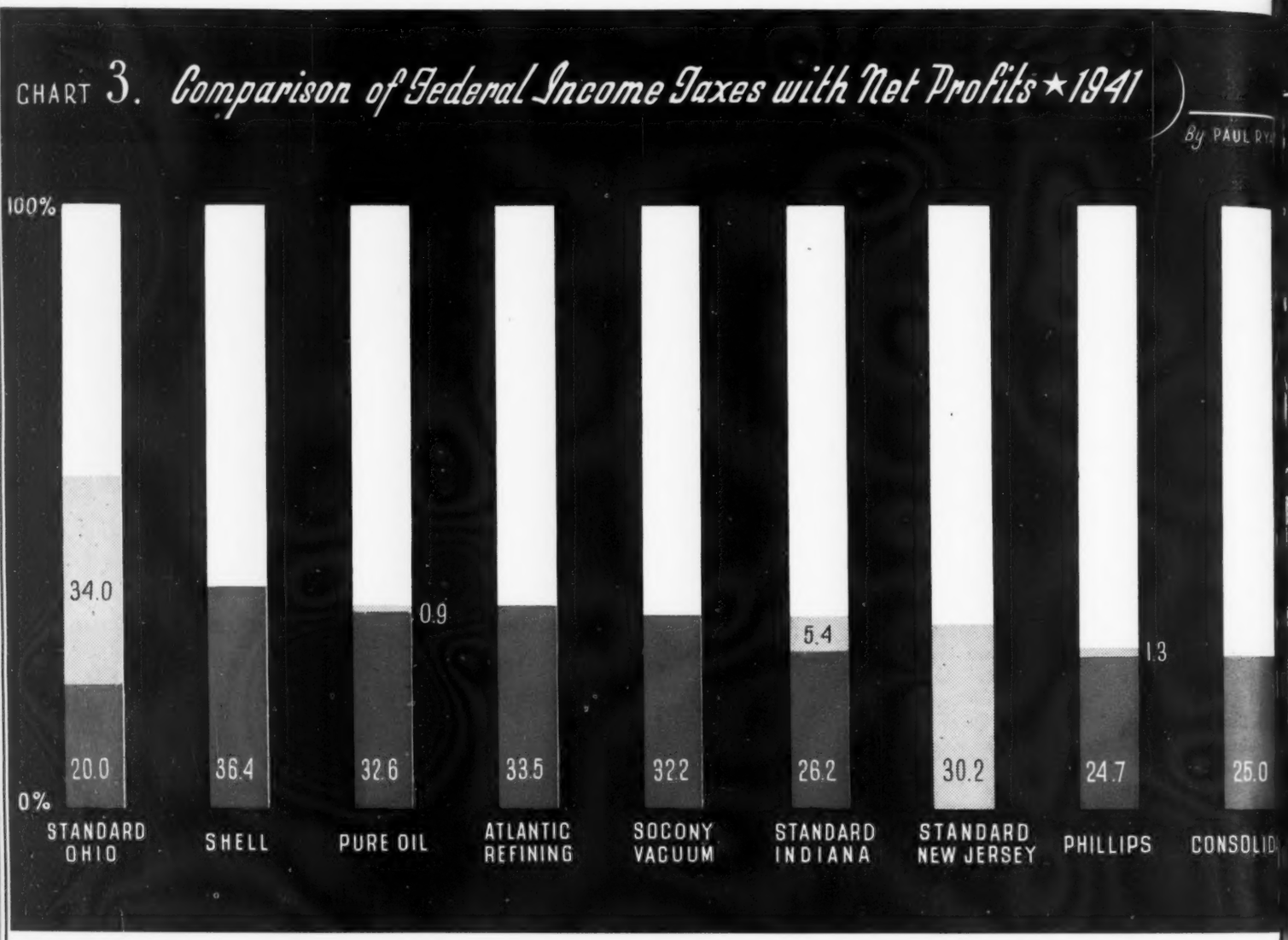
TABLE 2

COMPARISON OF PROFITS AND TAXES
for
18 LEADING OIL COMPANIES: 1941

Company	Profits before Federal Income Taxes ($1,000,000)	Federal Income Taxes: Normal and Surtax ($1,000,000)	Federal Income Taxes: Excess Profits Tax ($1,000,000)	Percentage of Total Taxes to Profits before Taxes: Total Taxes %	Normal and Surtax %	Excess Profits Tax %	Net Profits ($1,000,000)	Percentage of Total Taxes to Net Profits %
Standard - Ohio	13.5	2.7	4.6	54.0	20.0	34.0	6.2	118.0
Shell	27.2	9.9	0	36.4	36.4	0	17.3	57.2
Pure Oil	23.0	7.5	0.2	33.5	32.6	0.9	15.3	50.3
Atlantic Refining	21.5	7.2	0	33.5	33.5	0	14.3	50.3
Socony-Vacuum	63.6	20.5	0	32.2	32.2	0	43.1	47.5
Standard - Indiana	70.8	18.5	3.9	31.6	26.2	5.4	48.4	46.3
Standard-New Jersey	201.2	60.6	*	30.2	30.2	*	140.6	43.1
Phillips	23.5	5.8	0.3	26.0	24.7	1.3	17.4	35.0
Consolidated	22.0	5.5	0	25.0	25.0	0	16.5	33.4
Sun Oil	21.7	5.2	0	24.0	24.0	0	16.5	31.5
Cities Service	2.1	0.5	0	23.8	23.8	0	1.6	31.2
Texas	67.9	15.8	*	23.3	23.3	*	51.9	30.5
Tidewater Assoc.	16.5	3.7	0	22.4	22.4	0	12.8	28.9
Gulf	44.3	8.7	0	19.6	19.6	0	35.6	22.4
Ohio	13.1	2.3	0	17.5	17.5	0	10.8	21.3
Standard-California	39.0	6.0	0	15.4	15.4	0	33.0	18.2
Union	7.3	1.1	0	15.0	15.0	0	6.2	17.7
Continental	17.2	1.8	0	10.5	10.5	0	15.4	11.7
Average				25.7				40.3
Average - excluding Standard-Ohio				24.0				35.7

N.B. - "0" means report states "no excess profit taxes paid."

* means report does not separate and identify excess profits taxes, or whether any were paid, but merely states "Income and Excess Profits Taxes."



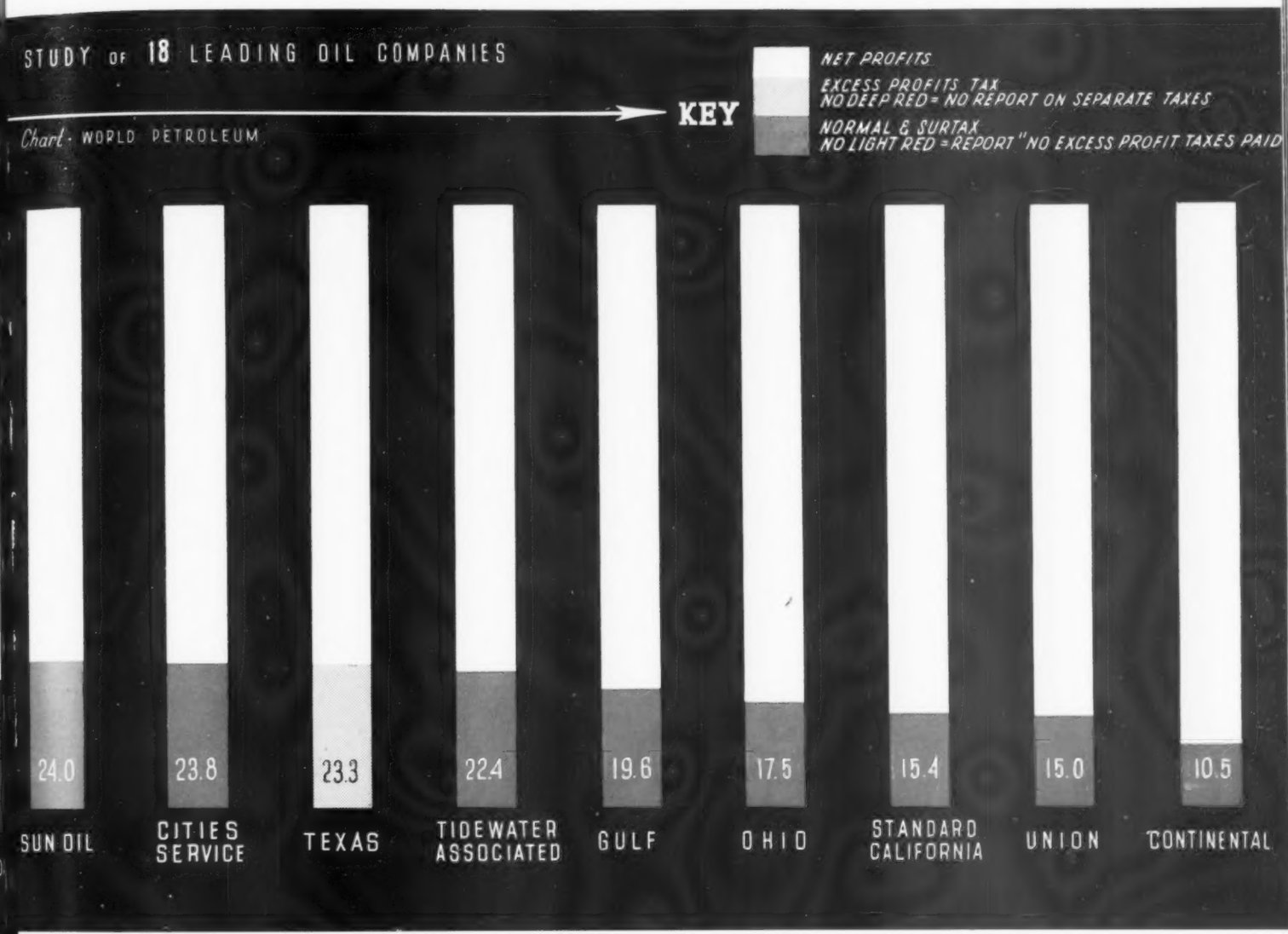
tal legal officers, and thus eliminate the "aura of fear" spread by them throughout the industry. With the assistance of Mr. Ickes, Mr. Davies and the OPC, the Petroleum Industry War Council is performing a splendid task, but does the public knowledge of intra-industry cooperation include also the refinery superintendents of "competitors," their transportation chiefs, their sales managers? Such united efforts are absolutely essential to the success of our war effort; such public knowledge is essential to good industry-wide public relations.

(8). Emphasize repeatedly to the public that the oil companies are working closely together to help win the war; build a sound public appreciation for the efforts of the industry based on a complete knowledge, (within the limits of military secrecy) of the collaboration and cooperation of the individual companies. This knowledge and understanding by the public is the soundest insurance to prevent unwarranted attacks by publicity-seekers (private or governmental), because a widespread appreciation of facts renders futile the efforts of those who deal only in half-truths. Use sound public relations to make the oil industry invulnerable to attacks, from interlopers within and from demagogues without.

Particularly is it necessary to inform the public now about the oil industry's great contributions to the war program. Thus the industry can lay the foundation for a sound public appreciation of the industry's war-time public service, thereby providing a strong defense for the industry in the post-war period, when the reformers and politicians will undoubtedly urge further governmental control over the industry, by claiming fullest credit for all war-time accomplishments and successes of the oil industry. The industry should invest in intelligent public relations now, during the war, and gather the dividends after the war, when they will be most needed.

(9). Eliminate whatever remnants exist of the discarded policy of "the public be damned." Too frequently, management's past active hostility toward the public has calmed to an attitude of apathy and negation; this, in turn, should be replaced by an active solicitation of the public's friendship, based on a consummate realization that the public's attitude "makes or breaks" any enterprise.

The Securities and Exchange Commission has wisely and properly altered corporate financial procedures to correct abuses by compelling "full and complete disclosure" of financial matters; wise executives, realizing the necessity for deserving public support, are making "full and com-



plete disclosures" of other pertinent matters affecting the public to invite the public's beneficial interest and sympathetic understanding.

Such creation of public support and understanding should be positive, aggressive, and on the offensive. The oil industry should not delay bringing matters to the public notice until after some self-seeking politician has "broken the front pages" with his own interpretation of half-truths which will glorify him and detract from the industry.

The executives of the oil industry must recognize that there is no other industry which has such frequent contacts with the public; therefore, any matter concerning the oil industry and its relations to the public is of great public interest. To assure a favorable interpretation — and, by all means, a factual one—the oil companies should release to the public their own story of their actions, before any politician can release his story.

The oil executives must realize by now that, if it is at all possible for human ingenuity to distort any matter, some self-seeker will turn the spotlight on himself, as "the savior of the people," and force the industry to fumble, stumble, and squirm about to defend itself in a most unfavorable light.

The industry should not allow, through its own delays and lack of aggressive public relations, any politician to throw the industry on the defensive; it should beat the politicians "to the punch," by giving to the public a constructive statement on each matter, which will not only build up the public's understanding of the industry's participation in the war program, but will intensify the public's appreciation of the industry's consideration for the comfort and convenience of the public during these war times.

Such complete and frank disclosures of the company's affairs, before the politicians can make cheap political capital out of the incident, will not only effectually prevent the politicians from acting against the best interest of the company, but will create a most necessary favorable public attitude toward the company.

(10). Capitalize on the increasing manifestations of people's interest in public affairs.

Most people are suffering, during this war, by giving their fortunes and their lives, and the lives of their own flesh-and-blood. In such a crisis the nation needs, and is demanding, aggressive, forceful leadership, instead of the buck-passing inefficiency and pusillanimous refusal to pursue

realistic and necessary action—the mounting public impatience and disgust evidence that these two defects have too long characterized our Washington executives and legislative governmental representatives. Now is the time for the oil industry to evidence the leadership in public affairs, relating to the oil industry, which the industry itself has demonstrated in developing its own internal operations. People want forceful action now; the oil industry should assume the necessary leadership in its own affairs by forceful, aggressive, intelligent public relations programs, to benefit the industry now, and to protect it in the future by achieving public support, approval, and patronage.

These suggestions for an intelligent program of public relations by the petroleum industry arise from the experience of executives, in various industries, who constantly realize more forcefully their dependence upon the public's opinion, attitude and action. These executives have learned, from experience, of their great need for continuously stimulating that public opinion in a constructive manner. Other industries have been faced with the same problems as now confront the petroleum industry; they acted, and now can rejoice in a sound, supporting public opinion, based on full knowledge, sympathetic understanding and active interest, which not only has effectively stopped time-wasting, costly attacks but actually has multiplied their profits, with an assured satisfactory financial patronage.

This war has proved to the general public, whose thoughts are "public opinion," that private industry is worthy of the public's complete confidence and support. The enthusiastic cooperation of industry with the war program has won the hearty approval of those 40 million wage-earners, who are neither public office-holders nor members of organized labor, who truly appreciate the monumental tasks which the management of private industry has undertaken, to cooperate with the great masses of people in their desire to achieve victory in this war. The pressure of war responsiblities has crushed the leadership of the politicians; it has exalted the public's opinion of most private industrial management.

Industry has demonstrated that, to win the war, industry itself is patriotic enough to forget old animosities, to cooperate with politicians, who, for their own selfish ends, had roundly persecuted industry; and that industry is willing to subordinate fundamental differences of internal political and economic problems to conquer an external enemy who threatens America's way of life. The general public now is beginning to realize, more so than our professional post-war planners, that united American industry—management, suppliers of capital, and the workingman—will win this war, and that at the conclusion of the war, after the industrial strength of America has made its force felt so strongly throughout the world, as to conclude the war victoriously for the United Nations, this country must depend upon the virility and strength of its private industrial corporations to weather storms which will face not only American industry and American government, but the entire world.

Hence, we emphasize the extreme urgency that the petroleum industry prepare now for those days ahead, with the inevitable retribution and readjustment, by making our operations more efficient and more economical, by developing new ways of serving mankind and industry, by generating in the hearts and minds of our fellow Americans, on whom we must depend for our existence, a more constructive, a more beneficial, a more cooperative attitude not only toward the petroleum industry, but toward all American industries. If we succeed in achieving these objectives, we shall truly "Work for Victory, Prepare for Peace."

Below: Signs of the times. Recognized as permanently unprofitable this gas station has closed its doors.

Declining Rate of Discovery Poses

URGENT PROBLEM FOR OIL INDUSTRY

By A. I. Levorsen

Conservation of Petroleum Resources Calls for Increased Exploration and More Wildcat Drilling to Maintain Adequate Reserves in Face of Rising Demond

THE PETROLEUM reserve of the United States might be conveniently divided into two general classes: first, the developed or known reserve; second, the undeveloped or undiscovered reserve.

The development reserve of petroleum consists of those deposits that are now known to be present under the ground because wells have been drilled into them in sufficient number to prove their presence. It might be called the proven reserve and it is from this reserve of petroleum that the present daily production is being taken. It is being added to on the one hand by the current new discoveries and it is being depleted on the other hand by the current daily production. This reserve requires little or no additional drilling to produce it and to make it available for use, except when it becomes necessary to apply methods of secondary recovery.

Through the years numerous estimates of the amount of oil in this reserve have been made. It is not measurable in the accurate sense that an iron ore or copper deposit is measurable for the reason that it is found at depths ranging from hundreds of feet up to 10,000 to 13,000 feet—or upwards of two miles below the surface of the ground and it is physically impossible to expose enough information in any deposit to accurately know the true number of barrels which are present. And even if the true number of barrels were known, there are other factors such as gas pressures, water encroachment, gas-oil ratios, kind of producing equipment, and the economic variables which make for profit and loss—all of which are engineering factors which enter the problem of lifting the oil from deep in the earth up to the surface. When all such factors are adverse they may reduce the underground reserve by a quarter or even a third, leaving a variable amount in the reservoir rock after all the present recovery methods have been applied. These are some of the reasons why we call them "estimates" of the "recoverable" reserve.

Recoverable reserve estimates have been made by various governmental agencies, by trade journals, by oil industry associations and by private individuals and organizations. They are probably more accurate now than they were ten or twenty years ago because there is more production experience upon which to base the estimates and many more fields are considered which tends to average out any errors that might be made. The amount of the recoverable reserve has increased steadily through the years. For example, it was roughly 5 billion barrels in 1920; 10 billion barrels in 1930; and 18 billion barrels in 1940. As of January 1, 1942, an average of three independent estimates—those of The American Petroleum Institute, The Oil Weekly, and The Oil and Gas Journal—placed it at 19,804,304,600 barrels of oil recoverable by methods and under economic conditions of price and markets prevailing at the time of the estimates. These three agencies were in rather close agreement; they reflect the most modern concepts of engineering and oil industry practice, and can probably be considered as nearly accurate as anything that can be devised for measuring a material with so many variables attached to its recovery. At least they represent the majority opinion among oil men of the size of the recoverable reserve.

Along with the increase in the recoverable reserve estimates there has been an equally steady increase in the production and consumption of petroleum. This ranged from 442,929,000 bbl. in 1920; 898,011,000 bbl. in 1930, to 1,338,237,138 bbl. in 1940. The production in 1941 was roughly 1.4 billion barrels and will probably be close to or slightly less than this amount in 1942. In general, consumption keeps close pace with production, and through proration control, only enough oil is produced on the average to satisfy the consuming demand. In connection with the consumption of petroleum and its products, a factor which should be kept in mind is that consumption is complete and there is no residue of scrap left to cushion any abnormal demand as in many other mineral products. There is every reason to expect the future consumption to continue to increase as in the past either with or without the war.

There has been a rather constant relationship between the annual production and the amount of known reserve. In general during recent years it is that the reserve ranges in amount between 12 and 15 times the annual production. Just why this should be the case I do not know, but it probably reflects an equilibrium adjustment which includes many of the economic and physical factors involved. We, therefore, recognize today in the oil industry of the United States, a developed but unproduced reserve of some 20 billion barrels—or at the current rate of consumption, about 14 years of future supply. However, only a small fraction, possibly one-fourth or one-fifth, can be taken out during the next few years, and the remainder will be produced at steadily decreasing rates for possibly 20 to 30 years, or even more. In other words, without continually replacing the yearly consumption with new supplies, the oil industry would very soon find itself without sufficient oil to take care of its daily requirements, much less provide for the present rate of expansion and all of the war needs. This 20 billion barrels is our first line of defense and the winning of it is primarily an engineering and production problem.

Whether the present known reserve is on the order of 15 billion barrels, 20 billion barrels, or even 25 billion barrels is not as important as to know at what rate it can be produced without damage. Producing at too rapid a rate means an excessive loss of producing energy which is translated into a loss of ultimate production. As long as there is an excess producing capacity resulting from proration practices, there is not much danger of hurting the reserve. However, if it should be necessary to produce at a rate faster than sound engineering permits, it will quickly result in the loss of ultimate reserve capacity. It is my understanding that detailed studies are now being made in the Petroleum Coordinator's Office of the amount of excess producing capacity of the country and not until that work is completed will we have much, if any, idea of the current production safety factor.

Our second, or long term line of defense—and it is undoubtedly the more important and is the crux of the entire reserve problem—is the ability of the oil industry to discover the new supplies necessary to replace the present known reserves as they are consumed. This must continue year after year and the few years margin of safety we now have is so narrow that this nation cannot afford to get behind in its discoveries. The only way out is to make new discoveries.

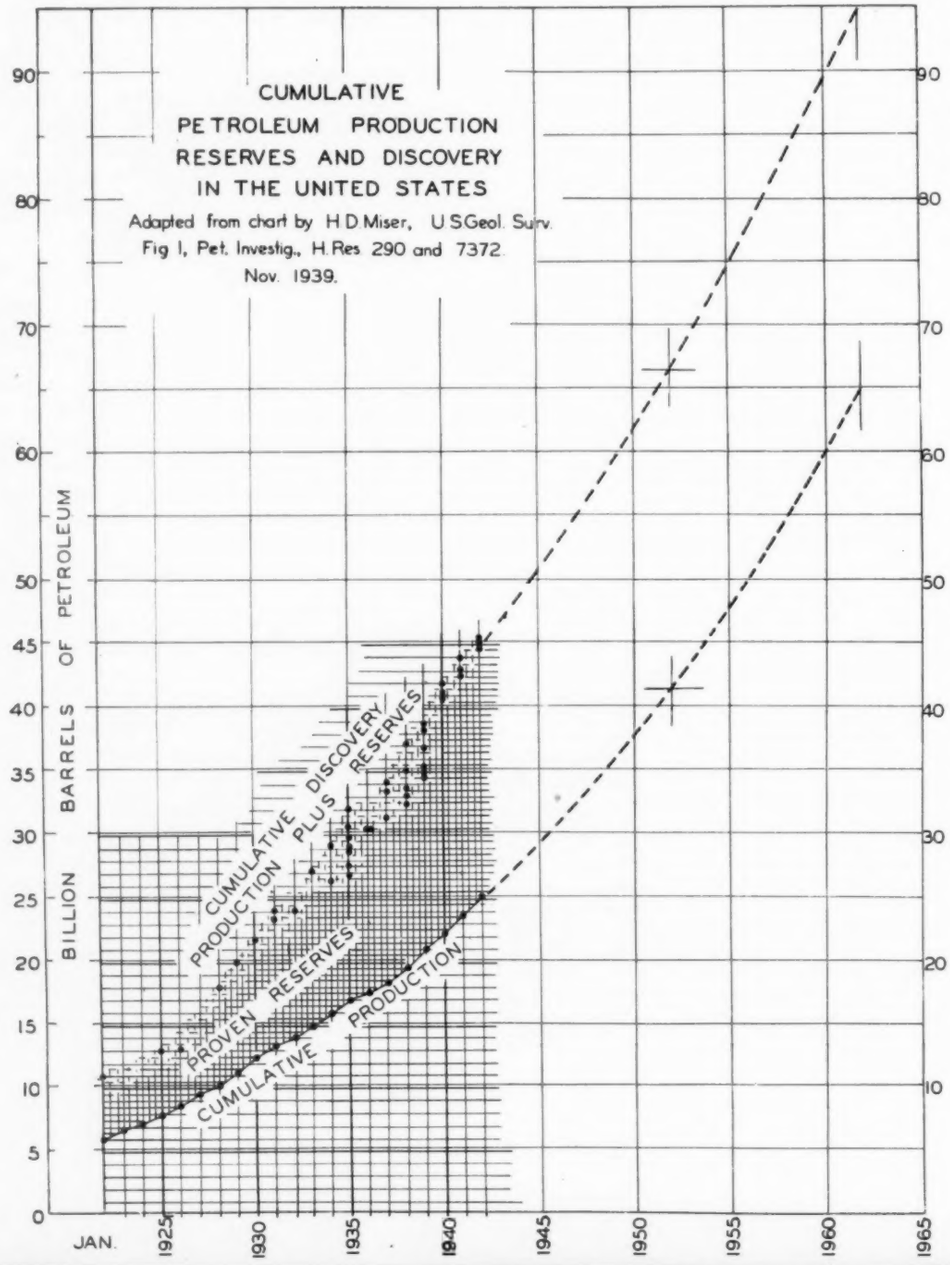
The sum total of all discoveries since the beginning of the oil business in 1860 to the present has been on the order of 45 billion barrels. Of this, approximately 25 billion barrels have been produced and consumed and the remaining 20 billion barrels lie underground as a reserve or stockpile. If projected into the future, at the same rates of expansion, we find that by 1952—or ten years hence—there will have to be on the order of 22 billion barrels more added to the discoveries, of which 17 billion will have been produced and the remaining 5 billion should be added to the reserve. In 1962, or 20 years hence, the cumulative discovery is on the order of 90 billion barrels, of which 60 to 65 billion will have been produced and consumed and 25 to 30 billion barrels should be in the underground reserve. In other words, during the next 20 years, if we are to maintain the same rate of

Abridged from statement presented before Subcommittee of the Committee on Public Lands, United States Senate.

increase in supply and demand and the same ratio of reserve to annual consumption as has prevailed during the past 20 years, it will be necessary to add—by discovery or some now unknown method—oil on the order of 45 billion barrels. This is equal to the total amount found by all methods during the past 80 years.

Figures such as these, in the face of a current inability of the industry to find enough new oil fields to maintain the reserve, clearly shows that something is wrong. If the decline in discovery is due to the lessening amount of oil remaining to be discovered—that is, an approaching exhaustion of our ultimate reserves—then the situation is indeed serious. If, on the other hand, it is the result of an insufficient effort to make the necessary discoveries, then it is not so serious because ways can be devised to remedy the situation. Let us then consider the question of whether or not there is reason to believe there is oil in sufficient quantities left to discover. In other words, do we have an undiscovered reserve supply of "much" oil or "little" oil in terms of our national needs of the future?

In approaching such a problem as this, with the same data available to all, we find the answer in part depends on whether the evidence has filtered through a pessimistic or through an optimistic mind, because it is a human characteristic for some persons to see the glass "half empty" while others see it "half full." Moreover, since the occurrence of oil is related to rocks and earth history, the evidence upon which an answer is made must be geological in nature. It depends on the geological philosophies of the occurrence, migration, origin, and accumulation of oil and gas deposits as they relate to the known geology of the country. These ideas are changing constantly, especially with added data, and it is easy to see how, twenty years ago, it was thought that the future production of petroleum in the United States was relatively small—for at that time but relatively little was known of the geological conditions throughout much of the land. The limited viewpoint of that time, based on limited knowledge, resulted in a limited outlook for the future. Today we have a much broader viewpoint based on much more data, a better philosophy concerning the formation of oil fields, and more understanding—and as a consequence our future outlook now is much expanded. We find there are enormous volumes of sedimentary rocks, generally favorable to oil accumulation, which are at present unexplored and consequently only partially known, and because of this we can say with considerable assurance that there is "much" oil yet to be discovered. The location of some of the larger portions of this relatively unexplored territory—the "big game" hunting ground, if you will—which is considered as being favorable to the ultimate discovery of petroleum reserves may be divided into two groups or types of areas, as follows:



1) The undiscovered reserve within the area of current development and production. It would be accounted for by such things as deeper producing formations, extensions to present producing fields, and to the many favorable areas which come to light continually with the normal development of active provinces. It represents the bulk of the current discoveries and is considered as the most available of the reserve for the immediate future.

2) A little less apparent, but certainly of greater ultimate importance to the future, are those reserves which may be expected to be found in the partially explored regions fringing the areas of current development. Some of the larger of such areas, areas in which thick sediments are found yet which are virtually unexplored, are:

(a) The trans-Mississippi region of the southeastern United States — Florida, Georgia, Alabama and Mississippi.

(b) The trans-Pecos region of west Texas and New Mexico.

(c) The Anadarko basin of western Oklahoma and adjacent parts of Texas, Colorado and Kansas.

(d) Numerous basins up and down the entire length of the Rocky Mountains.

(e) The plains region of North and South Dakota, Nebraska, and parts of Montana and Wyoming.

(f) The northern two-thirds of the San Joaquin Valley in California.

Each of these regions is characterized by large area; by thick sediments, which are known to have produced oil in neighboring provinces; by numerous evidences of oil and gas within the area; by much geologic history and by geological characteristics favorable to oil and gas accumulation; and many are located where access to present markets is not too much of a problem. In other words, the geology in each of these areas may be called "big geology" and the resultant discoveries may also be expected to be big, from a national viewpoint. Certainly, within any one of these areas, the eventual discovery of 25, 50, or even 100,000 barrel wells is a strong possibility and the geology is on such a large scale that there is nothing in our present-day concepts of the size of oil fields which may not be exceeded.

One example, out of many that might be cited, shows the nature and some of the factors common to the discovery problem. It is in the Dakota region, one in which I have had some recent experience. There we find two states largely underlain by sedimentary rocks in thicknesses ranging up to well over 10,000 feet. The region is geologically related to the adjoining parts of Nebraska, Wyoming and Montana and is but the southern extremity of an enormous province extending all the way to the Arctic Ocean in Canada, and is there known as the Alberta geosyncline. Around the edges of this larger province are several large oil accumulations such as Lance Creek in Wyoming, Turner Valley in Canada, and many fields in Kansas. In addition, one of the largest acumulations of oil in the world, the Athabaska tar sands, occurs on the eastern side of the area in Canada—an accumulation variously estimated at 100 to 200 billion barrels. Thus, not only are there known to be large volumes of sedimentary rocks, but these rocks are also known to be productive on all sides.

Within the past few years upwards of six million acres of leases have been taken in the Dakotas; large amounts of money have been spent in geological and geophysical surveying in the search for suitable traps, and five or six deep test wells reaching into or close to the basement rocks have been drilled. Some of these test wells are reported to have cost in the neighborhood of $200,000. No commercial oil was found in any of the wells although considerable thicknesses of porous layers of rock were found in all of them and several minor showings of oil and gas were observed. All in all, in spite of these favorable findings, so far the results are highly discouraging. And yet, from what is known of the geological conditions, not only in the Dakotas but in the continuing regions of Canada, when and if the answer to the accumulation of oil should be found—in other words, if ever one well should discover oil in commercial quantities—it would immediately open up the entire territory to the Arctic Circle for active exploration. Such a well might be the next one that is drilled—that is the picture might be reversed overnight—or it may not be drilled for many years. The geology is on such a vast scale that if a discovery should be made it might well be equally large and could easily change the whole course of oil exploration on this continent. To a greater or lesser degree, similar experience and reasoning applies to each of those areas listed above. None of them should be allowed to be abandoned by default. As a matter of fact, most of the producing provinces which are known today were preceded by discouragements and failures in much the same manner, and many of them were condemned as impossible by the best talent of the time.

In my opinion, the question is not in any sense a lack of prospective favorable, but unexplored oil territory within the United States. There is nothing in petroleum geology which limits the amounts of oil which may be found in areas such as these. It is true, they may ultimately be found to have very little oil present, but from our past experience, we have every reason to believe that the opposite is true, and that such vast amounts of favorable rock conditions as we already know to be present will sooner or later be translated into correspondingly large oil reserves. The problem then becomes a question of the adequacy of the discovery methods which are being used and which may be expected to be used in the future.

There is only one method of discovering oil and gas pools and that is by drilling wells. The reasons for making the locations of these wells vary from the most casual, unreasonable, and hit or miss, to the most scientific and carefully thought out, and all have been known to produce results. As time goes on, the exploration costs keep mounting, due in part to the steadily increasing depths, particularly of the wildcat wells; to more complex geological conditions with the greater depths; to higher labor and material costs; to greater detail in the data required; and to the many governmental rules and restrictions piled on the industry. With the mounting costs, the industry is gradually turning more and more of the discovery thinking over to the geologists, or what might be called the scientific approach to the problem of oil finding.

Geological thinking finds its application in the established fact that every commercial oil and gas pool is found in porous layers of rocks which are so situated as to form a trap from which the oil and gas cannot escape. The scientific search for oil then consists in finding these traps and drilling test wells on them with the hope that they will contain oil. The search for these traps has become extremely technical and they are becoming progressively more difficult to find. The most common trap is one in which the rocks are folded or deformed into what are called anticlines or domes often termed "structures." These have been found by surveying the rocks at the surface of the ground but more recently by means of geophysical methods — methods which apply various principles of physics to the geological conditions underground. Much of the present search for suitable structural traps is by means of geophysical methods, and the declining discovery rate indicates the failing effectiveness of this most recent and effective means of search. Another type of trap, and one from which a fourth to a third of the oil heretofore found in the United States has been produced, is called a "stratigraphic trap" in contrast to the structural type which has so far been found to be more common. These traps give very little advance indication upon which to locate test wells and in the past have generally been discovered by random drilling. That they are important is evidenced by the fact that many of the largest individual fields in the country are found in them—fields such as East Texas, Glenn Pool in Oklahoma, Coalinga in California, and Bradford in Pennsylvania. They are just now being studied intensively in the oil company laboratories of the industry with the hope that some way will be found by which they can be located more readily than at present, because they definitely represent an almost untouched field of exploration and one in which those familiar with the possibilities find to be almost inexhaustible. When it is remembered that in the East Texas Field alone, a favorable stratigraphic area only 55 miles long will

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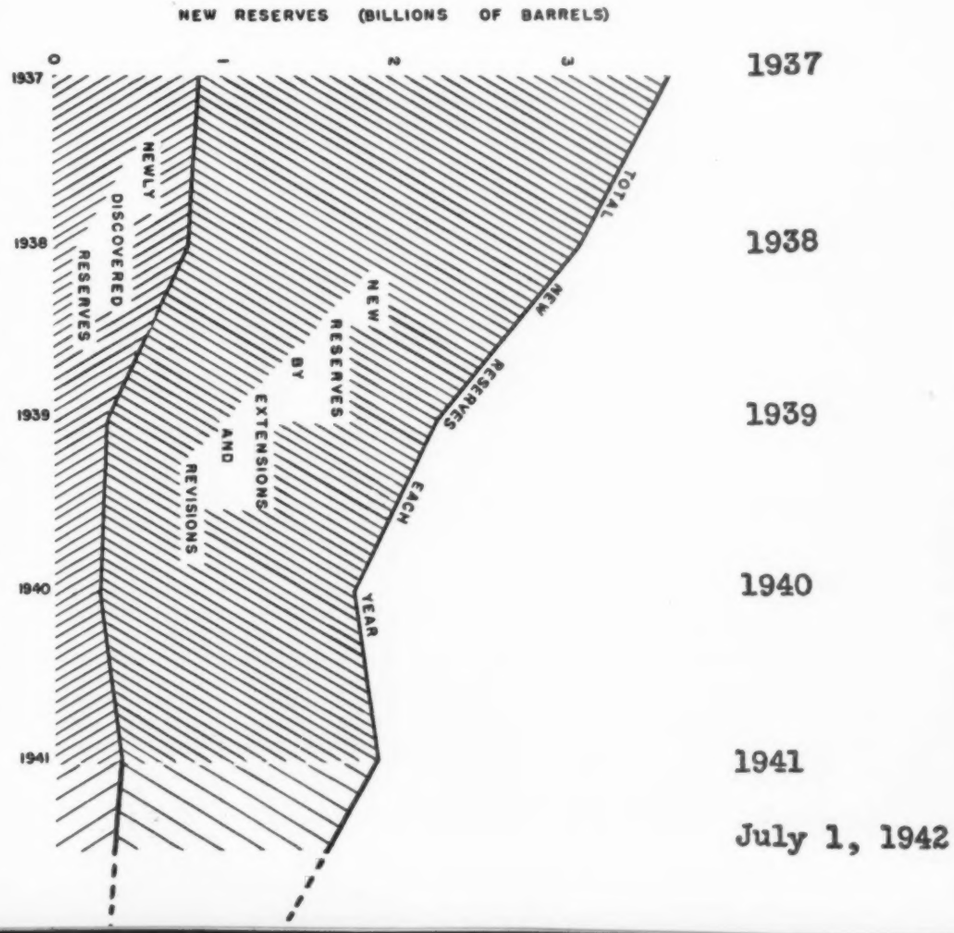

OIL TRANSPORTATION SYSTEM REVOLUTIONIZED TO MEET WAR CONDITIONS

1. Great activity is taking place in pipe line construction, extension, relocation. View shows Buckeye trencher excavating ditch for feeder line.

2. Laying first section of War Emergency Pipe Line, world's largest, 24-inch diameter. Photo courtesy H. C. Price Co.

3. Lining up joints on War Emergency line which will move 350,000 bbl. daily. Photo courtesy H. C. Price Co.

4. Applying protective wrapping to a large midwestern gas line. Photo courtesy Caterpillar Tractor Co.

5. Pushing Portland-Montreal line through Vermont's granite-ribbed hills.

6. Backfilling a newly laid line in New England.

7. Construction work on Plantation Pipe Line which transports petroleum products from Baton Rouge, La., to Greensboro, N. C.

8. Looping a Texas-Chicago natural gas line on its route across Iowa.

9. Three of these machines excavated 83 miles of hard pan, sand and gravel through California hills in 30 days to step up the movement of crude. Photo courtesy Buckeye Traction Ditcher Co.

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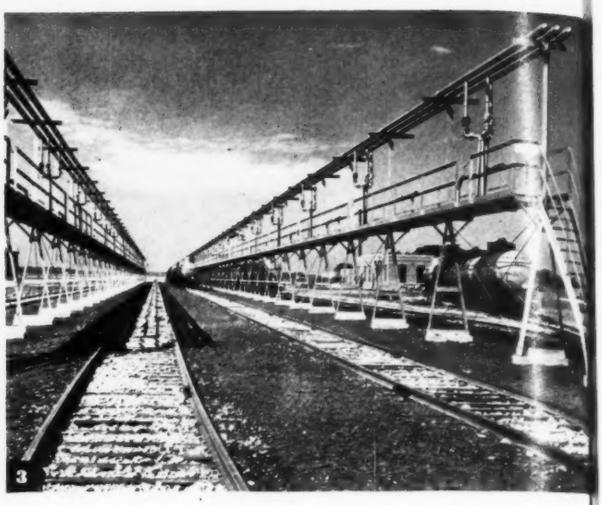

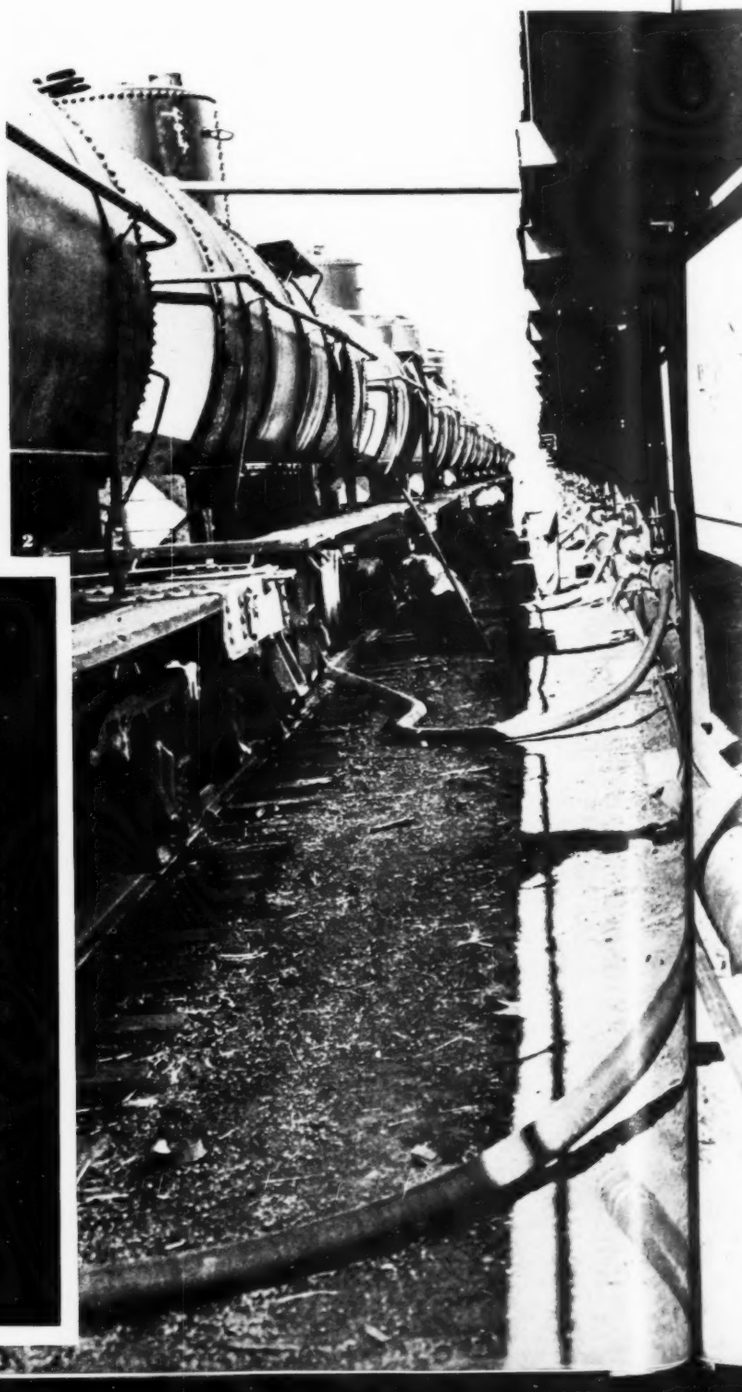

1. Solid trains of tank cars move oil from Texas and Mid-Continent to Atlantic Seaboard traveling on express schedules.

2. Hundreds of hose connections enable tank trains to discharge cargoes in record time. Time saved at terminals is an important factor in speeding up oil movement.

3. Change from sea to land transport has made it necessary for oil companies to construct elaborate loading racks for rapid filling to tank trains averaging sixty cars each.

4. Some of the 70,000 tank cars that have been pressed into service to keep the East Coast shortage of petroleum products from interfering with essential industrial activities.

5. Tank cars loaded with petroleum war supplies leaving a southwestern refinery for a swift run to the Eastern seaboard.

6. Moving crude and petroleum products in solid trains, non-stop from producing and refining centers to bulk distributing points in the East the railway companies have increased the daily movement of oil from 10,000 barrels to over 800,000 barrels—an achievement that was pronounced impossible before Pearl Harbor.

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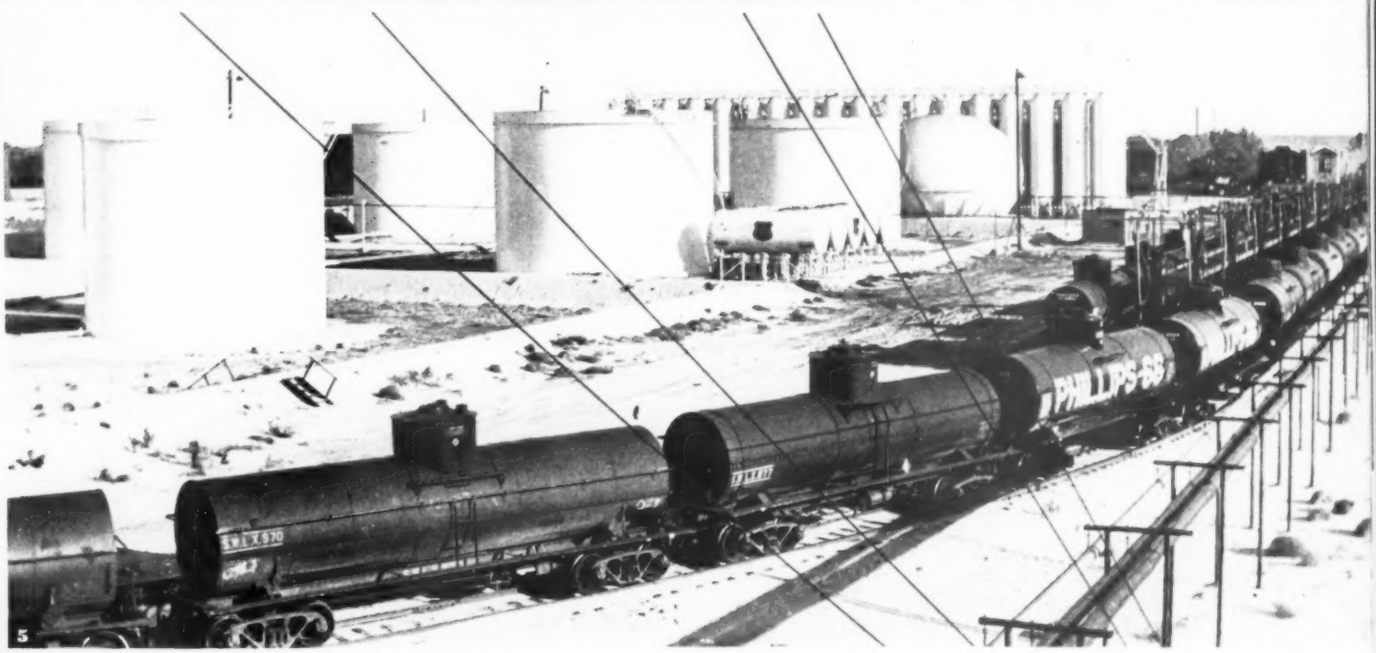

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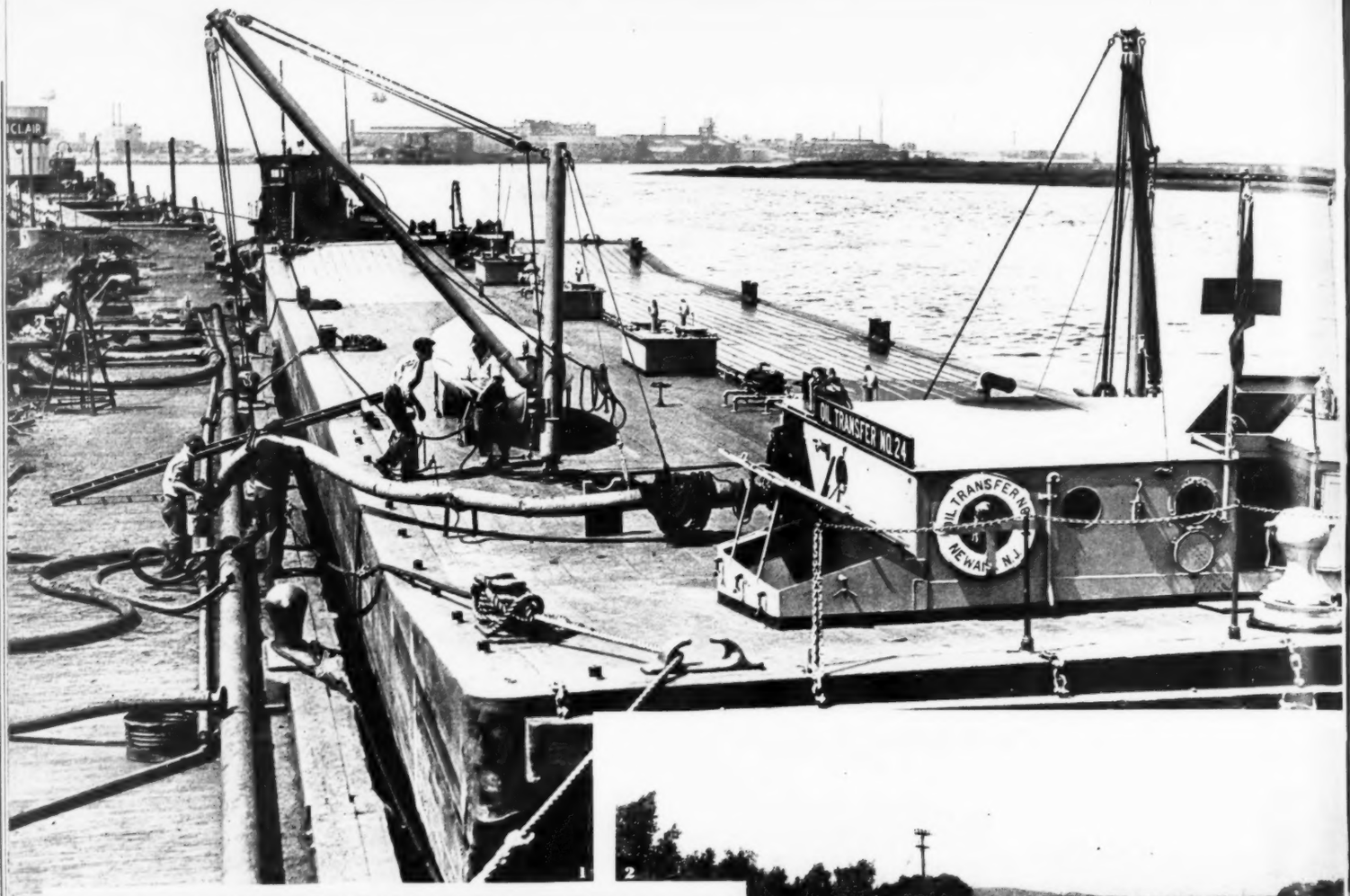

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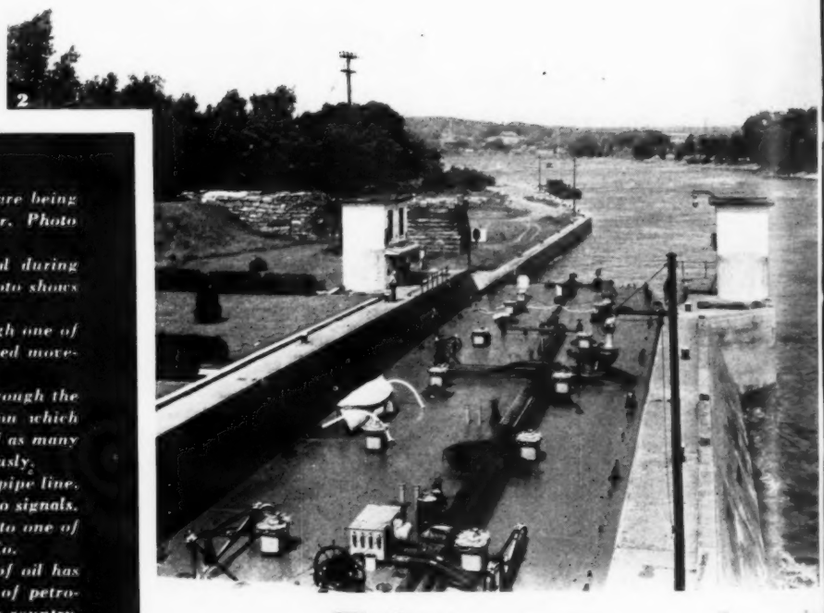

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1. *After its long cross-country journey 12,000 barrels of oil are being pumped into a transfer barge for a trip up New York Harbor. Photo courtesy Oil Transfer Co.*

2. *Large volume of oil travels eastward through Erie Canal during season of open navigation in specially constructed barges. Photo shows such a barge passing through a lock of the canal.*

3. *Oil barge with decks awash from heavy load on trip through one of the Great Lakes. Increased use of this route has greatly assisted movement of oil to Eastern seaboard area.*

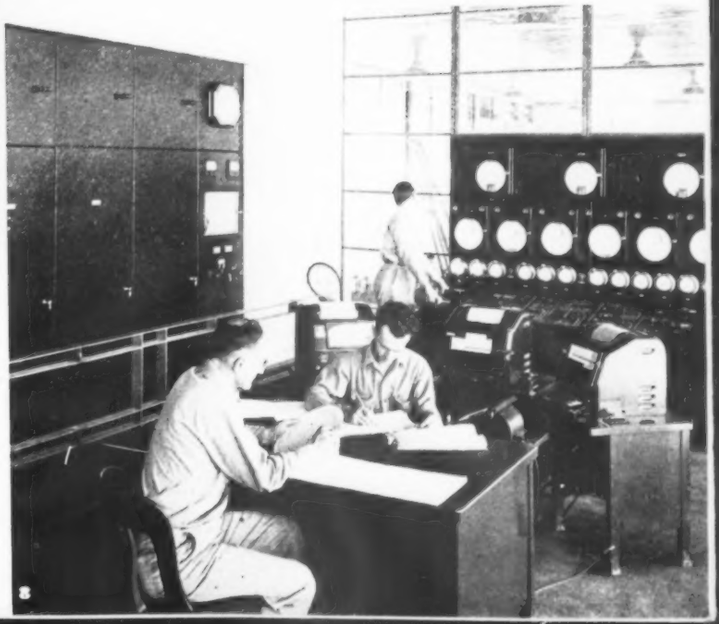
4. *Exact records are kept of the progress of oil shipments through the nation's maze of pipe lines. Photo shows the long sheets on which operators of the Plantation Pipe Line record the movements of as many as eight different products traversing the line simultaneously.*

5. *Traffic control is essential to the successful operation of a pipe line. The opening and closing of the many valves are the stop and go signals. In this view an operator is opening a valve to pass a product to one of the line's filters. Photo courtesy Plantation Pipe Line Co.*

6. *Diversion of railway tank cars to the eastward movement of oil has left the tank truck as the main reliance for the distribution of petroleum products from refineries to markets in many parts of the country. Photo by Orville Snider from Triangle.*

7. *Diesel powered trucks with trailers move oil at high speed and in large quantities throughout the West and Southwest. Photo by Snider from Triangle.*

8. *Pipe line dispatchers operating from a station control room and keeping all offices along the line posted on the products moving through the line, where the various grades and products are, how fast they are moving and the locations at which specified quantities are to be delivered. Photo courtesy Plantation Pipe Line Co.*



Oil industry's part in nation's expanding ar

A Chronology of Principal Events

From the date of the President's declaration of a national emergency, in May, 1941, oil has been primarily a war industry. The energies of the industry's members have been directed to meeting the swiftly mounting demands for products for military use. To this end their own interests have been sacrificed wherever necessary. Civilian consumption has been restricted; the output of certain products has been reduced and that of others has been accelerated. Heavy financial losses have been accepted, the industry's transportation system has been revolutionized, new and unexpected tasks have been undertaken and accomplished.

Through it all the industry has kept insistently at the one big job of supplying war materials on time and in the full quantities needed. It has multiplied its output of aviation fuel, toluene and war chemicals. It is moving at high speed to replace the nation's lost supply of natural rubber. It is doing whatever is necessary to keep planes flying, ships fueled and tanks rolling in a war arena that is world-wide.

So much has happened so quickly that it is difficult to keep in mind the sequence of events and to realize the changes that have taken place and the progress made in the brief period of sixteen months. To present a panorama of these developments and to provide a convenient record of important events the following chronology of the petroleum industry's wartime activities is presented herewith.

MAY, 1941

On May 27, 1941, the President of the United States declared the existence of an unlimited national emergency and called the nation to an all-out effort for national defense. The next day he appointed Secretary of the Interior Harold L. Ickes as Petroleum Coordinator for National Defense, and directed him to coordinate the efforts of the industry in meeting the emergency.

Earlier in the month the industry had not much to complain of. Domestic consumption was at a record figure, with expectations of more to come. The pre-existing defense program had stimulated a large demand for heavy fuel oil, and a great demand for aviation fuel was in sight. The system of priorities on essential materials was creating some difficulty but had not become critical. But this picture was already troubled by the first appearance of what was to be the industry's greatest headache in the months to come—problems of transportation. Fifty tankers to help the British had been withdrawn from service between the Gulf Coast and refineries on the Atlantic seaboard. The idea of a 24-inch pipe line from Texas to the New York area had been broached. Rationing was foreseen unless a sufficiency of oil products could be made available to the densely populated Eastern States. The OPM had begun to see the need of conserving steel. The government asked the industry to halt further rises in the price of gasoline. Manufacturers of oil burner installations were worried about the effect upon their business of the transport difficulty.

Left: This spectacular aerial photograph was taken of a U.S. tanker torpedoed by an Axis submarine. Despite a raging fire which sent columns of black, oily smoke billowing into the sky, crew members were able to bring the flames under control and the tanker was towed to port by a U.S. naval ship. Official U.S. Navy photograph from British Combine.

JUNE, 1941

The tanker shortage began to be felt. Stocks were accumulating on the Gulf Coast for lack of bottoms and were diminishing on the East Coast for lack of supplies. Various measures were taken. The load line of tankers was reduced so that those in service might carry more. Preparations were made for rushing construction of new tankers and oil barges. Readjustments in pipe line systems to combat the shortages of transportation were taken under consideration. Construction of a pipe line from Portland to Montreal was decided upon. Oil field allowances were being reduced and refinery operations curtailed for lack of markets. Exports of petroleum from the East were placed under license. Shipments to Japan were stopped. The Netherlands Indies refused further supplies of oil, tin and rubber to Japan. Ralph K. Davies was appointed Deputy Oil Coordinator. Coordinator Ickes called leaders of the oil industry into conference and outlined his policy, which was based on cooperation between all interests. Five regional headquarters were established, to be manned by experts taken from the industry. One of the first tasks undertaken was to increase production of aviation gasoline 25 percent. Government control of prices made its first appearance in an order to reduce prices of California oil. The industry was warned that it would have to conserve steel. Construction was started in a small way for manufacture of Buna and butyl rubber by private initiative. The Madison oil suits came to an end. The threat of anti-trust prosecutions in emer-

gency cooperative efforts was lifted. Railroad interests in the Southeast were blocking pipe line projects. The first two fluid catalytic cracking plants were started.

JULY, 1941

As the month opened many phases of the oil industry were at all-time peaks with best prices since 1937. Despite loss of export markets demand was greater than in any previous six months. Difficulties began to thicken however; the industry was faced with the loss of 50 more tankers, which would definitely unbalance the situation. Automobile production of 1942 models was ordered cut 50 percent. Priorities were making it difficult to provide operating facilities, especially steel and alloys. During the first half of the year 5,000 miles of pipe line were completed or under way in the Mid-Continent and Southwest, with little benefit to the East. A 20-inch line from East Texas was proposed, approved, and surveys started. Coordinator Ickes called for more use of tank cars and began to talk of rationing. Voluntary reduction of gasoline in the East by one third was requested (this came after the largest month's business in the history of the industry). The Cole Bill, authorizing exercise of the right of eminent domain for pipe lines essential to national defense was passed. Tank car owners were organized for coordinating shipments and the first large movements of oil in tank cars was begun. Barge shipments were increased.

The organization for coordinating the oil industry was proceeding. The five district offices were located and District Committees began to organize. Meanwhile the industry was facing a shortage of certain metals and alloys. It also got another taste of price control: the price of gasoline was pegged at 6 cents.

The long sheet which this workman is inspecting is synthetic rubber made from petroleum refinery gases at one of the Standard Oil Company (N. J.) plants.

AUGUST, 1941

OPM took control of steel for the oil industry. Price control was extended to Pennsylvania lubes. In the midst of many new records in production and consumption the industry was notified by Deputy Coordinator Davies that business as usual was out. Some tankers were diverted to Russia. The organization of District Committees was completed and the chairmen met with Secretary Ickes. The principal problem was to correct the Eastern supply situation. Limiting service stations to 12-hour operation was proving ineffective in reducing consumption. Suppliers in the East were ordered to reduce deliveries 10 percent. To speed up deliveries a tanker control board was formed and rates on tank car shipments were reduced. Surveys for the big line from the Southwest were about complete and contracts for construction were prepared; 400,000 tons of steel was the calculated requirement. Home users of fuel oil were warned to expect curtailment.

Various measures to conserve essential materials were instituted. The industry was asked to avoid drilling of "unnecessary" wells as against public policy. Use of high grade blending agents was restricted, and refiners were asked to double capacity for making aviation gasoline, which would call for $10,000,000 worth of new facilities.

SEPTEMBER, 1941

Over protests by the Office of Petroleum Coordinator SPAB refused to allocate steel for the Texas-East Coast pipe line and action on bids was indefinitely postponed. Search for additional tank cars for service to the East was intensified; flow was reversed in certain pipe lines. Shippers and railroads agreed on reduced rates, which were still three times higher than for pipe line and tanker. The increased cost prompted demand for higher prices, which were long to be denied. Meanwhile, production reached an all-time peak; domestic consumption still offset loss of exports, though the 10 percent cut in gasoline production continued. Coordinator Ickes still warned of shortage, and OPC put forth new plea for more aviation gasoline. SPAB was vested with authority to say how much oil could be stored or sold and who might use it. The oil industry was given A-10 priority for essential materials, though procurement of equipment was becoming more difficult. Nevertheless, many refiners had adapted their operations to the changed conditions. Manufacturers of equipment and natural gasoline producers started prorating deliveries. High grade crudes were segregated for aviation gasoline. Something over 100,000 bbl. per day was being transported in tank cars to the Atlantic states.

OCTOBER, 1941

The month opened with a demand for a three-fold increase in aviation gasoline production, which was now at the rate of 40,000 bbl. per day. Fifty new units costing $150,000,000 were considered necessary to bring production to 120,000 bbl. per day by summer of 1942. The first shipment of toluene derived from petroleum for explosives was made from Houston. Forty-nine tankers were ordered built; arrangements were made to utilize road trucks to supplement rail haulage. All of a sudden the East Coast situation showed signs of improving. Some tankers were returned and all restrictions on fuel oil in the East were dropped. A six-point program was set up to overcome deficiency in production of aviation gasoline, which touched a peak of 43,278 bbl. per day this month.

Meanwhile domestic production rose to 4,117,475 bbl. per day to meet war demands; reserves were sinking and a call arose for more drilling. The industry was passive to this demand unless it were allowed a higher price and the necessary steel. Curtailment was ordered for Ohio, but was soon rescinded. The demand for higher prices was taken under consideration by OPA. OPC and OPM were urged to expedite distribution of equipment to the industry. Rail transport to the East rose to 120,000 bbl. per day. The CIO started a movement to unionize the oil industry's 500,000 workers.

NOVEMBER, 1941

The American Petroleum Institute held its first annual meeting since the unlimited emergency in San Francisco. Coordinator Ickes disclaimed any wish to be "Oil Czar"; called for greater output. The Institute pledged cooperation and said that all demands made on the industry would be met. Stocks in the East were rising again and Eastbound tank car movements began to fall off. The SPAB formally rejected the proposition to build a large capacity pipe line from Texas to the New York area. OPC was advised to prepare for eventual shortages by building auxiliary pipe lines, arranging for overland and barge transport and especially by restricting consumption. One hundred and ninety tankers were under construction. The old system of priorities was dropped and a global tonnage of steel was allocated to the oil industry by OPM for OPC to distribute. Needs for 1942 were put at 5,846,000 tons, on the basis of drilling 30,000 wells. Crude oil production rose to 4,329,365 bbl. per day. While production was running ahead of demand the refineries had nearly reached their limit of capacity. Emphasis on production of aviation gasoline was causing difficulty from accumulation of other products, especially ordinary gasoline. Production of lubes for aviation was especially wanted. With withdrawals exceeding discovery there was insistence on exploration and for higher prices as an encouragement to wildcatting; instead, OPA "requested that prices of all petroleum products be frozen on a nation-wide scale as of October 1." In conformity with this request, recent higher prices were withdrawn.

Steel for manufacture of drums and cans was cut one third, and OPC called on the oil industry to see whether it could find and use 5,000,000 wooden barrels. An urgent campaign was begun to secure the return of empty drums to the refineries. The petroleum industry was now working under a curtailment of 26.5 percent in gasoline production. Export restrictions on low grades were lifted in the East. Automobile engine manufacturers were beginning to plan for post-war cars to operate on 100 octane number gasoline. At this time a shortage of lead and chlorine began to be felt and TEL was put under allocation, foreshadowing reduction in the octane number of market gasoline. The refineries were given high priorities for making aviation gasoline and told to treble production. Standard Oil Co. of La. contracted for the third fluid catalytic plant.

DECEMBER, 1941

The month opened with runs to stills highest in history. Further expansion was waiting on OPA to make up its mind about price increases. A Petroleum Industry Council for National Defense was named by Coordinator Ickes. Tanker rates were cut.

On December 7 Japan declared war on the United States, Great Britain and the Netherlands; Coordinator Ickes ordered all operating divisions to be projected on the basis of a war economy. The Petroleum Industry Council for National Defense held its initial meeting, and was called on to get all oil needed for national defense by stepping up production and refining and curtailing civil use. The immediate problem was to enlarge production of aviation gasoline; plant capacity to produce 150,000 bbl. per day by July 1, 1943 was projected. Base stocks suitable for aviation gasoline were ordered earmarked for this purpose, ordinary gasoline to be made from low grades; current production of aviation gasoline was then 50,000 bbl. per day. The government announced that it would finance new plants or make three-year contracts for plant output. The Army agreed to tolerate 4 cc. of TEL. OPC took control of all blending materials. Recovery of light products was ordered for all refining and natural gas plants. Pooling of base stocks and other components of aviation gasoline was directed. Clearance of anti-trust proceedings was promised for necessary cooperation in the national emergency. More plans for new aviation gasoline plants were announced and given high priorities; owners of patents on aviation gasoline processes reduced royalties. Continued failure of OPA to advance prices was causing confusion; a three cent advance per bbl. in Texas was allowed. OPM was making a search for inactive refineries to send to Russia. The industry was warned that tankers would be requisitioned. A shift of tankers to the Pacific Coast took place. Britain returned 13 more tankers.

Axis submarines began to sink tankers in the Atlantic, and shelled refineries on the Pacific Coast. The industry began to experiment with black-

Above: Deck view of torpedoed tanker immediately after being struck. Crewmen are battling flames from upper companionway. Note how the concussion of the blast has twisted the steel railings and ladder. Official U.S. Navy photograph from British Combine.

outs. To meet need for greater steel production the industry received a first call to turn in junk and scrap. Order M-68 was issued to conserve steel by limiting new drilling to one well per 40 acres for oil, and 640 acres for gas. Allocations were promised to those who complied. A blanket of official secrecy was clamped on all information about processes and locations that might be of use to the enemy. Naphtha isomeration appeared as a new process for aviation gasoline.

JANUARY, 1942

The year just closed witnessed a record production of crude oil—1,391,544,457 bbl; demand was also a record—1,506,161,000 bbl.; reserves were estimated at 20,299 million bbl. Fuels for war became the oil industry's No. 1 assignment. The order went out to install equipment for maximum recovery of butane, isobutane and isopentane; all new plants must install such equipment. Blanket priority in materials was extended to the industry. Unitization of oil fields was forced by Order M-68 limiting oil wells to one per 40 acres, and this order brought numerous pleas for exceptions. Ceiling prices were put on petroleum products as of No. 1, 1941. Rates of production in Illinois and Oklahoma were reduced to secure better proration. The War Production Board was created under Donald Nelson. The Elkins act put a top on pipe line earnings. Contracts were being let for 100 octane number gasoline and military toluene. The refinery market was clouded by the impact of war on gasoline consumption. Manufacture of automobiles for civilian use was prohibited after February 1. The octane number of premium gasoline was reduced to conserve blending agents. The industry was losing technologists to the draft.

The problem of supplying the Atlantic Coast re-

appeared in more acute form. Many tankers were being sunk; others were transferred; stocks were declining in the East. Tank car movement eastward again began to increase, reaching 58,725 bbl. per day by January 10. Tanker construction was speeded up and was now at highest level since World War I. Pipe line construction was stimulated and interest again was being directed to building a big-diameter line from Texas to the New York-Philadelphia area.

Alongside the urgent 100 octane gasoline problem the no less urgent problem of synthetic rubber arose to confront the government and the refining industry. Imports of natural rubber were almost entirely cut off. Production of synthetic rubber, including the "vinyls" was only about 30,000 tons a year—less than five percent of requirements. The government announced that $400,000,000 would be available for contracts to build more synthetic rubber factories. To conserve stocks drastic regulations were imposed on the distribution of rubber tires. Patents and processes for the manufacture of rubber substitutes were being pooled. Drives to bring in steel scrap were being organized, and agitation was begun to start a drive to bring in old rubber.

FEBRUARY, 1942

The monthly statistics showed that motor fuel demand rose in January. So far it had not appeared that gasoline consumption was much affected by restrictions on tires. Maximum price levels for petroleum and petroleum products were established as of October 1, but prices of gasoline began to decline. Stocks in the Eastern area were decreasing. The war in the South Pacific, in the Caribbean and along the Atlantic Coast was greatly complicating matters for the industry. Movement of tankers were curtailed by military requirements and by enemy action; up to the middle of the month nine tankers had been sunk. To meet the needs of the East shipments of crude oil by rail were increased; during the first half of the month the movement by tank car had risen to 165,000 bbl. per day, topping the past year's peak of 145,000 bbl.; before the end of the month tankcar shipments had rised to 256,725 bbl. per day. In other directions the transport problem had become uppermost; pipe lines were operating to their limit. In some cases not enough pipe line capacity was available for state allowables, and pipe line shipments were prorated in West Texas and New Mexico. Coordinator Ickes again took up his fight for the big line from Texas to the East. The transportation shortage forced major changes in production quotas.

A second synthetic rubber plant was awarded to the Pacific Coast. The use of tin cans for packaging petroleum products was restricted. The Petroleum Industry War Council was formed.

MARCH, 1942

At the beginning of the month more than a million bbl. of tanker capacity had been sunk since Pearl Harbor; the remaining capacity was prorated among shippers. Proration of pipe line capacity was spreading in Texas, New Mexico and Louisiana. Tank car shipments began to take on larger proportions, and during the month reached an average of nearly 450,000 bbl. per day. Stocks continued to decline in the East, and to pile up on the Gulf Coast, where more refineries reduced operations and some discontinued. The large volume of rail shipment was imposing larger costs on the Eastern refiners and agitation was begun for higher prices. The OPA took the matter under advisement. The OPC let it be known that higher prices were also needed to stimulate drilling a minimum of at least 19,000 new wells. New drilling was declining and agitation was begun for pooling drilling supplies. Coordinator Ickes made formal application for 460,000 tons of steel for building the Texas-New York pipe line, and the WPB refused it. Pending the granting of higher prices the refining industry agreed to share among themselves the higher costs due to rail transport. Coordinator Ickes and Price Administrator Henderson argued over the necessity of rationing gasoline and fuel oil. The number of tankers in coastwise service was reduced from 192 to 157 while orders of the WPB cut the gasoline supply of 17 eastern and two West Coast states by 50,000,000 bbl. a year.

Meanwhile estimates of requirements for 100 octane gasoline were raised to 250,000 bbl. per day and production plans were shaped accordingly. A standardized three-way plant to produce distillate, butadiene and toluene was disclosed. A goal of 400,000 tons of synthetic rubber to be produced by 1944 was set; facilities for an ultimate production of 600,000 tons a year were under construction or in process of negotiation. Plans were being made to raise tank car movements to 600,000 bbl. per day, for which 20,000 more cars would be needed.

APRIL, 1942

Tanker transport of oil was further restricted. At the same time transport by tank car was greatly increased and by the end of the month had passed 500,000 bbl. per day; some thought it would eventually exceed 600,000 bbl. To facilitate movement of oil toward the areas of shortage there was much revamping of pipe lines, and new lines were built of reclaimed piping. Little or no new steel could be had for pipe line construction. Expenses of refiners depending on tank cars greatly increased; freight costs equalled or exceeded the posted price. Some price increases were allowed but these were not sufficient to prevent loss. Inability to ship reduced allowables of many independent producers on the Gulf Coast below profitable operation. Deep cuts were made in May quotas. Refinery operations on the East Coast were reduced to 65 percent of normal gasoline production. Gulf Coast refineries were grouped in four classes according to the importance of their operations to the war effort; those making 100 octane fuel, military lubes, toluene, etc., were to keep in full operation; the others could divide the non-essential business between them. Consumer gasoline rationing was invoked against non-essential driving in the East. Refinery operations in general were directed toward less gasoline and more fuel oil. Daily petroleum demand was now 500,000 bbl. per day less than on December 7, 1941.

Coordinator Ickes announced his intention of making renewed application for the big pipe line from Texas. The shift toward production of war materials and emergency products went forward rapidly; 36 companies were making aviation gasoline, and production was over 200,000 bbl. per day. The synthetic rubber program was being pushed; 14 companies got contracts or letters of intent for 700,000 tons. The goal was set at 800,000 tons a year and there was talk of raising it to a million. Patents on synthetic rubber and 100 octane gasoline were opened to all without royalty. Production of butadiene became the bottleneck of the rubber program. Due to transportation difficulties the OPC reshuffled allocations for production of crude oil on the basis of state reserves.

MAY, 1942

The blight of war now spread to more divisions of the petroleum industry. The great lag in making price adjustments to cover higher transport costs was severely felt; some small advances met a portion of the excess costs, which were estimated at $580,000 a day. Later in the month the OPA and WSA agreed to absorb these costs. The industry was warned to proceed on the assumption that no tanker transport would be available. WPB made its rejection of the big pipe line final. Consumers in the East were warned that inland transport would not cover their usual needs. Conversion from fuel oil to coal was urged. Tank car movement rose to a peak of 684,482 bbl. per day but the daily shortage was still 400,000 bbl.

Due to shrinkage of usual outlets the outturn of non-war products had decreased 650,000 bbl. per day since December 7. The way of refineries without war contracts was becoming hard, but in other respects the industry was greatly expanding. War-time investment in refinery equipment was now twice that of peace time; total new investments on account of synthetic rubber, 100 octane gasoline and military toluene was expected to reach a billion dollars. The natural gasoline industry, which was in a low state during January and February was very active under orders to recover all butane and other light products. Refinery technology was being revamped to produce less gasoline without reducing total output. New techniques increased yields of war products. Detailed data were submitted for the oft refused big pipe line from Texas. The RFC raised the goal of synthetic rubber production to a million tons a year. While some progress was being made in the rubber program, the situation

was much confused, and the confusion was increased by demands put forward by the farm bloc in favor of alcohol from farm crops as a starting material. Gasoline rationing in the East went into effect to conserve gasoline and rubber.

JUNE, 1942

There was some indication that the troubles of the industry were beginning to mend a little. Though much of the industry was in the red, operations were intensive. The WPB finally approved construction of the big pipe line from Texas to Norris City, Ill., which by the end of the year would afford some relief to the war-blighted East and the greatly inconvenienced Gulf Coast. Deliveries were still short of bare essentials, and more drastic rationing was in prospect. Tank car movement hit a new peak of 731,520 bbl. per day. To help the shortage of steel the industry was carrying on a great drive to bring in scrap metal, and to relieve the rubber shortage which was restricting civilian driving the industry organized a general drive for scrap rubber which brought in over 450,000 tons. Regulations were issued regarding allocation of crudes to District 3 refiners in proportion to their importance in war work. To stimulate production of war materials price ceilings were removed from aviation gasoline, butadiene and toluene. The Connally hot oil law was made permanent. July allowables were increased, a sign that decline in runs to stills had touched bottom. Meanwhile spacing regulations under order M-68 had reduced drilling 58 percent in the face of an estimated demand for nearly four million bbl. per day for the war effort. The outlook for synthetic rubber continued to be clouded by politics and by jockeying among proponents of rival processes. Not more than 30 percent of the refining facilities for the 800,000 tons synthetic rubber program were under contract; 25 projects had been started but few were advanced. Small refineries were beginning to pool their facilities so as to participate in the war program. Preparations were made for permanent rationing in the East. The first fluid catalyst plant was put in operation.

JULY, 1942

Statistics for the half year just closed showed that crude oil production was 741,557,000 bbl., demand 776,000,000 bbl., both records. New discoveries were one fourth of withdrawals, well completions were down to 9,392, a drop of 4,861. During the month tank car movement rose to 788,550 bbl. per day. Prices were advanced to cover increased freight costs. The Navy began convoying tankers in a limited way. The WPB finally approved the big pipe line from the Southwest, and unwound red tape that was blocking other essential lines. The Eastern supply situation was still critical. Refiners were called on to expand runs to stills to meet war demands while the problem of equipment procurement still lacked a permanent solution. Technical progress now made it possible to obtain 30 bbl. of 100 octane gasoline per 100 crude, ten times as much as formerly. Texas celebrated completion of her 100,000th oil well. Rationing was extended to additional Eastern territory and there was not enough gallonage to supply the rations. Some refiners were making as little as 65 percent of their normal gasoline output. The rubber program was occupying much of the public interest. Plans were drawn up for production of 800,000 tons of synthetic rubber by fall of 1943, without provision for non-essential civilian use. Of this amount the petroleum industry was to produce two thirds, leaving one third for alcohol from various sources; butylene instead of butane was made the technological basis for Buna S rubber. Pending the main program, efforts were made for production of "quick" butadiene at all possible refineries. New technical progress permitted greatly increased production of butyl rubber and also an inferior grade called "flexon."

AUGUST, 1942

The program of "quick conversion" of refinery facilities to increase the output of war materials got well under way, and was bringing more plants to work on toluene, benzene, isobutane, butadiene and codimer for aviation gasoline. Isobutylene production was stepped up for butyl rubber. Inland refineries were assured peak runs; authorized output for September was fixed at 4,066,500 bbl. per day, for which higher quotas were allowed in some cases. The DSC plan of absorbing abnormal transport costs was now assured and ceiling prices were reduced in District 1. Gasoline demand turned down, but on the whole the effect of shortages and rationing did not reduce overall consumption more than 23 percent. Tank car transport was now organized on a solid train basis; 67,411 tank cars were in the Eastern service and movement of crude to Eastern refineries reached a record average of 830,820 bbl. per day. Construction of the big pipe line got under way; arrangements were made for the trans-Florida line. There was much agitation for conversion from fuel oil to coal in the East.

The Baruch Committee was appointed to clarify the rubber muddle and its relation to the problem of civilian driving. Work on synthetic rubber facilities was being pushed, and conversion of equipment for quick production of butadiene was receiving attention. Butane was given renewed consideration as a raw material, and the alcohol industry was awarded a share amounting to 225,000 tons in the synthetic rubber program. The materials situation was becoming tighter; WPB adopted the policy of making the industry "live off its fat" by forcing pooling of materials and redistributing them where most vital; for this purpose it was insisted that the whole industry make an inventory of its resources. Refiners were authorized to pool information. Although crude production was at high levels, drilling was 40 percent under normal and there was concern over dwindling reserves.

SEPTEMBER, 1942

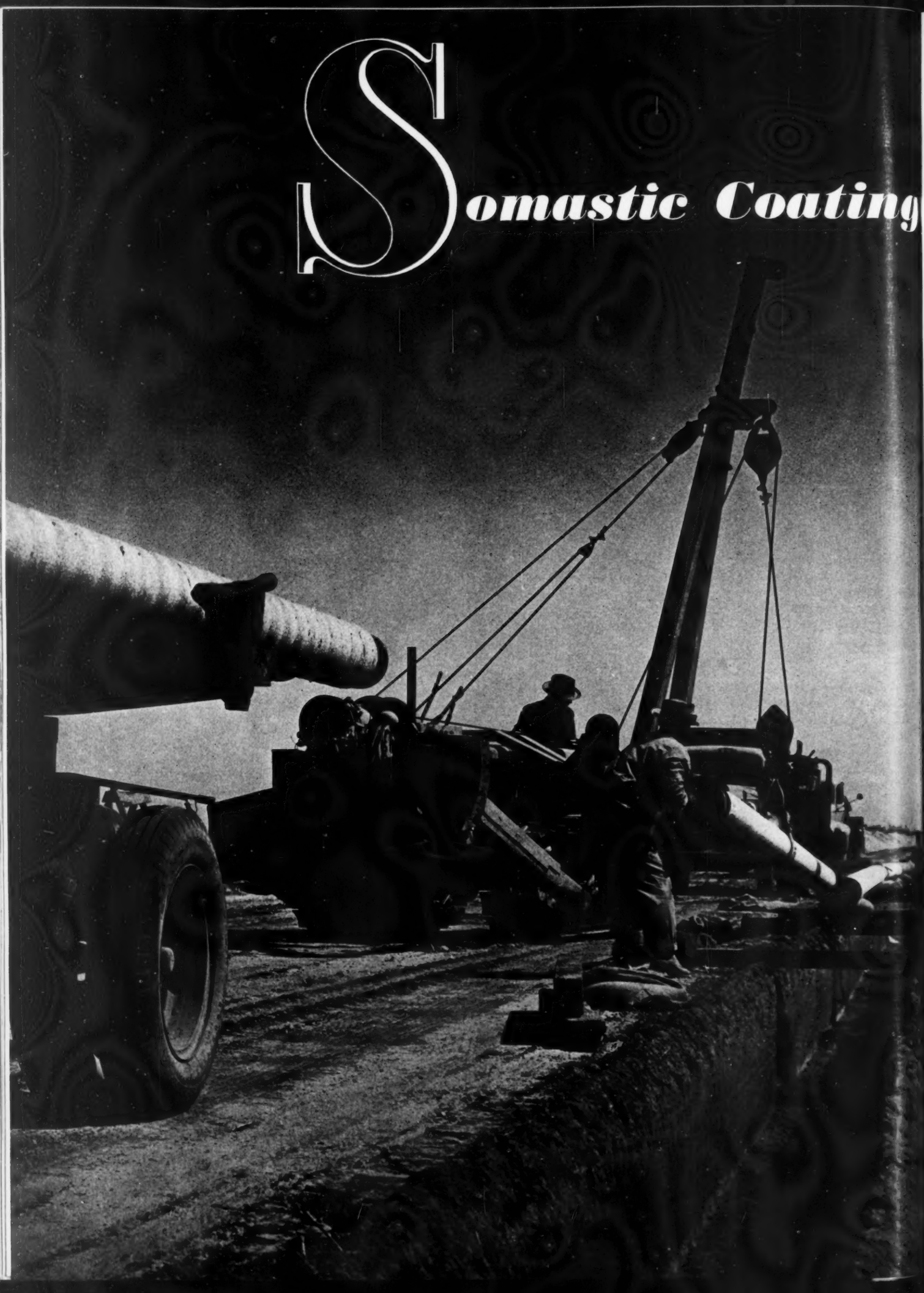
Production statistics highlighted the deëmphasis of motor fuel production and emphasis on fuel oil. Gasoline yields now averaged 37.8 percent on crude, lowest since 1928: yields of kerosene and light fuel oils were 30 percent, a 100 percent increase. Fuel oil use in 30 Eastern states was ordered reduced 33⅓ percent; the reduction amounting to 100,000,000 bbl. per year. By abolishing short hauls to obtain more cars the tank car movement eastward was raised to 838,440 bbl. per day. One third of the big pipe line from Texas to Illinois was now completed, and there was much pipe line construction going on in West and Southwest. WPB was working on plans to expand production of 100 octane gasoline that would call for still greater capacity. Gasoline demand was surprisingly strong. M-68 was liberalized for some states, but no priorities were allowed for close spacing. The Baruch Committee turned in its report on the rubber situation, recommending forced saving of tires by limiting driving to 5,000 miles per year, speed limit to 35 miles per hour, mileage rationing for commercial vehicles, increase of synthetic rubber production to 1,100,000 tons per year to maintain essential civilian driving, tieing production of butadiene with production of other war materials, appointment of a single rubber administrator, and nation-wide rationing of gasoline. W. M. Jeffers was appointed rubber administrator to execute this plan.

OCTOBER, 1942

Rubber Coordinator Jeffers announced his intention to provide some replacements for essential civilian driving at the earliest possible date. Nationwide rationing of gasoline was set for November 22: domestic fuel oil consumption in rationed areas was ordered reduced 33⅓ percent. Tank car movement East reached 856,710 bbl. per day. Application was made for extension of the 24-inch pipe line to the East.

Coordinator Ickes called on the industry to provide more than 4,000,000 bbl. of crude a day to maintain the 100 octane gasoline program; production was running below that figure. Sales income was the lowest in 16 months and the industry was demanding higher prices to stimulate new drilling; so far the OPA remained obdurate. The Interstate Oil Compact Commission made a plea for uniting all agencies dealing with petroleum under a single coordinator.

Meanwhile, under the leadership of Coordinator Ickes, the oil industry has already traveled far on the road of cooperation. The OPC has treated the industry as a unit in close consultation wtih its leaders. The aim, as announced by Deputy Coordinator Davies, is to have the industry function as a single integrated organization.


Somastic Coating

Uneconomic Use of Heavier Than Necessary Pipe to Retard Corrosion in Peacetime Becomes Indefensible in Face of Wartime Steel Shortage—Actual Savings of 30 Percent Steel Have Been Demonstrated by Use of Asphalt-Mastic Coating.

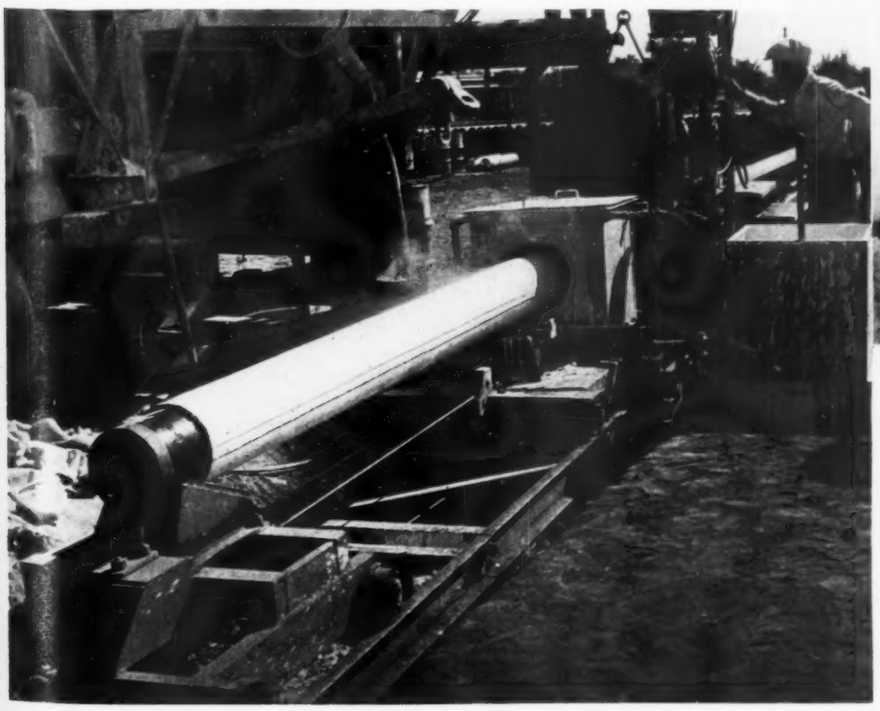
EFFECTS SUBSTANTIAL STEEL SAVINGS

AMERICA CALLS FOR MORE OIL, more gasoline, more natural gas! The demands of war are heavy. Every hour brings additional problems to the transportation agencies of the petroleum and natural gas industries. New plants spring up and create new cities. Existing plants expand. Work goes on and fuel is consumed around the clock. Military and naval establishments, ships, planes, tanks, trucks, jeeps and many another piece of fighting equipment tax to the utmost today's petroleum and gas transportation facilities.

To meet the country's expanded requirements greater carrying capacity is needed quickly. The industry is responding with every means at its command. New tankers slide down the ways in record time. Long-idle tank cars roll again. Over mountain and plain, river and sea, speeds the lifeblood of production. To date it has been a job well done but America needs more fuel, more lubricants—and tomorrow, still more. Above all America must have more pipelines—the transportation medium best suited to bear the brunt of the burden. Increasing pipeline capacities involves a complex problem which may be simply stated: to operate existing lines at maximum capacities, to build additional lines, and to attain both objectives with a minimum use of steel. The means are at hand to solve this problem in new lines through the use of light-weight steel pipe protected by suitable coating, and in old lines by reconditioning and protection by a suitable coating.

The owner's ideal is a line that functions continuously, free of shutdowns. The demands of war makes this goal even more desirable than in normal times. One factor essential to this condition is pipe in a perfect operating state, in the ground after completion of the backfill, not merely at the outset but for the useful life of the line. This involves a high degree of lasting protection against soil corrosion, demanding a material able to withstand handling, soil stresses and the other factors involved in transforming pipe into operating pipeline. It is further essential, of course, that costs be kept within bounds. Protective coating is, by its nature, a conservation measure. In ordinary times, its justification rested solely on considerations of cost. Having determined the pipe wall thickness required to withstand an operating pressure, the pipeline designer had a free choice, measured in terms of dollars, between buying added thickness of steel to forestall failure from corrosion or buying protective coating. But before a completely effective protective coating became available, the economic choice was not always clear. Thus, in certain types of soil it was not infrequent practice for pipeline engineers to anticipate corrosion losses by using steel pipe in weights ranging from 25 percent to 50 percent or more in excess of the minimum required by line operating pressures. When the right product was made available, however, coating was clearly indicated as the proper choice. Today, sound analysis will reach the same conclusion inevitably, not only on grounds of economy but also because scarce steel should not, and must not, be used to resist corrosion when it can be replaced with materials more effective, more abundant and less expensive.

It is true that a variety of protective methods rather than any specific one is being employed to achieve the desired results. Many men are attacking many problems. Operators' engineers and manufacturers' specialists are working together. A number of materials are involved. This is a common fight and competitors have enlisted on the same side for the duration. But let



Opposite Page: Swinging Somastic-coated pipe on skids.

Left: Freshly coated pipe proceeding through extrusion nozzle and whitewash chamber at railhead pipe coating plant.

Top: Workman applying thick over-lapping field joint of Somastic pipe coating.

us here examine the accomplishments of one coating product and one pipe reconditioning process as a good example of the progress being made under today's limitations of construction materials. Back in the early twenties one major pipeline operator set engineers on the quest for a complete solution to the corrosion problem. In asphalt they had at hand a basic material of extraordinary promise. Experiment, testing and more than a minimum of midnight oil went into the search for a mixture capable of satisfying strict physical standards and at the same time economically feasible. The quest involved starting from scratch with new application methods and new machinery for coating pipe.

All that is past history now. The A.P.I. National Bureau of Standards Tests, instituted in 1930, included the resulting asphalt-mastic protective coating as one of the materials buried at test locations and periodically re-examined. The findings of these tests are a matter of record. They show how right was the decision to seek in thick asphalt-mastic at least one solid answer to the demand for permanent elimination of corrosion damage to pipelines. For the figures show that correctly manufactured and applied, asphalt-mastic can safeguard steel pipe from corrosion in the most severely corrosive soil to a degree that is permanent, for all practical purposes. This is because asphalt-mastic possesses the physical characteristics necessary to meet practical pipeline requirements; namely, non-conductance of electrical currents, resistance to water absorption, adequate tensile strength, sufficient ductility to allow for field bends, strong resistance to depression forces, resistance to impact, and ability to

Top: The application of Somastic coating will safeguard against corrosion in highly corrosive soil, as encountered in swampy country.

Right: Shoving string of 16 inch coated pipe along approach to lake crossing.

Left: Field welding of coated pipe line.

Backing into position to push pipe string along canal right-of-way. By proper coating of pipe a lighter weight can be used for the same service, since extra steel, permitting a margin of safety for corrosion, is not required. Economical in peace time, such savings are essential in war time when additional pipelines must be built despite the scarcity of steel for this service.

establish a firm bond with the pipe. As applied today, the process consists of building an outer shell of asphalt-mastic around the pipe as a continuous, seamless coating. The mastic may be applied at central or railhead plant adjacent to the line, or over-the-trench by traveling equipment. In any case, the material is batched, mixed, and applied hot to previously primed pipe by special machinery.

The asphalt-mastic product, known commercially as Somastic pipe coating, can be applied to pipe of ¾ in. to 24 in. diameter. It consists of asphalt, graded mineral aggregate, and long-fibre asbestos, combined by weight and batched at carefully controlled temperatures. The reinforcement of the mixture through the use of limestone dust and sand, as well as the thickness of the applied coating, develops sufficient strength to withstand the rigors of ordinary pipeline construction methods. A firm bond of coating to pipe is secured by means of a special primer coat. These characteristics and proper application assure a final unified product of coating and pipe in place in the trench, to form an operating pipeline thoroughly protected against soil corrosion. For the eighteen-year period during which this product has been in place on pipe in the ground the absence of pipe failures from corrosion losses permits the supposition that the protective quality of this coating is permanent from a practical standpoint. This high degree of protection gives rise to the current practice of employing asphalt-mastic coating as a replacement for steel, by using it in conjunction with pipe of lighter than standard weight. Experience to date shows savings of steel up to 33 percent through the reduction of pipe weights from those previously specified under like conditions of operation by the engineers of pipeline companies now using this method on their lines. Costs are reduced simultaneously, for the protective material can be applied at a cost much lower than the value of the steel replaced. The procedure is to buy steel pipe only to the thickness required by operating pressures, relying upon the coating to preserve the original wall thickness of the pipe. Not offered as a formula, the accompanying table is interesting as illustrative of the substantial savings accomplished on recent work. The comparisons are between pipe weights used in the past under the same or similar conditions by the pipeline operators employing this practice, and the pipe weights now specified in conjunction with the commercial asphalt-mastic product, Somastic pipe coating. The six in. to 12 in. sizes tabulated on the accompanying table are considered indicative.

	6⅝ in.	8⅝ in.	10¾ in.	12¾ in.
	(Weights in pounds per lineal foot)			
Normal standard weight pipe ..	18.97	24.69	34.24	49.56
Lighter weight pipe used with Somastic pipe coating	12.89	16.89	22.86	33.37
Saving per lineal foot in steel ..	6.08	7.80	11.38	16.19
Saving in steel, percent.....	32%	31.6%	33.2%	32.5%

America's concerted effort to conserve steel for diversion to war production is a relatively recent development. Even so, the manufacturer of Somastic pipe coating, Industrial Engineering Company, estimates that on contracts completed during 1941 and now in production, this organization has participated in a saving for pipeline operators of 35,000 tons of steel through the employment of lighter-weight pipe in conjunction with coating; enough steel to build 10 better than average size cargo ships. The replacement of steel by asphalt-mastic releases a critical material and utilizes materials which exist in ample quantities.

Finally, there remains the matter of keeping existing lines operating at capacity, and of taking up old lines and relaying them. A brief examination of pipe reclamation practices will disclose a means of conserving existing steel pipe, particularly the "production line" method employed by Industrial Engineering Company to get a first-rate finished product in a short working time. From trench through process and back to trench, this organization's method keeps the pipe moving in a straight-through operation. The line is uncovered, pipe is taken up and intermediate welds or collars cut out. Joints out of true are straightened by a hydraulic ram. Next, internal residues and exterior coating or traces of paint are removed in a furnace, which heats the pipe uniformly along its full length to a temperature sufficient to remove internal stresses in the metal. Gradual cooling is followed by mechanical beveling to a 30 degree bevel for welding. The pipe then travels through a rotary shot-blast machine wherein a rotor, turning at high speed, impels steel grits against the pipe. Emerging, the surface exhibits a uniformly clean, bare condition. Pits, even those not easy to detect when filled with rust, are now clearly revealed and clean. Spot welding is employed to build up to required wall thickness the pits and wall areas reduced by corrosion. Tests are made by air pressure with plugs sealing the ends, and the reconditioned pipe is ready to be moved ahead to the coating plant for protective treatment. Standard usage specifies reconditioning and protective coating as a unit process.

The long established practice of reclaiming used pipe gains in importance with each additional war-time demand for steel. Unless badly damaged, the pipe may be brought to a serviceable condition, much of it comparable with new, rapidly and economically. Without a protective coating, however, much of the old pipe would not be worth relaying for want of sufficient wall thickness to withstand corrosion. This reconditioning development, and the companion practice of using lighter-weight pipe for new lines, with the impervious asphalt-mastic coating for maintenance or original wall thicknesses, afford a practicable and economical means of meeting war-time needs for additional lines and increased pipeline capacities with a minimum amount of steel.

PRELIMINARY PROGRAM AMERICAN PETROLEUM INSTITUTE

Monday, November 9, 1942, 8:00 P.M.

PROTECTION OF PETROLEUM FACILITIES

(Red Lacquer Room)

Wartime Facility Security:

(Sponsored by the Committee on Protection of Petroleum Facilities of the Petroleum Industry War Council)

Presiding: W. S. Farish, Standard Oil Co. (New Jersey), New York, N. Y.

The Army's Internal-Security Program.

Colonel H. G. Reynolds, Provost Marshal General's Office, Washington, D. C.

The OCD Facility Security Program.

Philip Bastedo, Deputy Director, Office of Civilian Defense, Washington, D. C.

The Coast Guard's Program on Port Security.

Rear Admiral Stanley V. Parker, U.S. Coast Guard, New York, N. Y.

Industry's Responsibility in Facility Security.

Bruce K. Brown, Assistant Deputy Coordinator, Office of Petroleum Coordinator for War, Washington, D. C.

8:00 P. M.

AUTOMOTIVE TRANSPORTATION

(Grand Ball Room)

Wartime Transportation:

(Sponsored by the Central Committee on Automotive Transportation)

Presiding: Leo Huff, The Pure Oil Co., Chicago, Ill.

Wartime Regulation of Petroleum Carriers.

S. F. Niness, Office of Defense Transportation, Washington, D. C.

Wartime Automotive Maintenance.

R. S. Williams, Office of Defense Transportation, Chicago, Ill.

Wartime Problems of Petroleum Carriers.

J. F. Winchester, Standard Oil Co. of New Jersey, New York, N. Y.

Tuesday, November 10, 1942, 2:00 P.M.

DIVISION OF REFINING

(Grand Ball Room)

Research:

A Four-Year Summary of Hydrocarbon Research.

C. E. Boord, The Ohio State University, Columbus, Ohio.

Physical Properties of Hydrocarbons in the Gasoline Boiling Range.

C. E. Boord, The Ohio State University, Columbus, Ohio.

Method for Analyzing the Gasoline Fraction of Petroleum, with Preliminary Results on East Texas and Oklahoma Crudes.

F. D. Rossini, B. J. Mair, A. F. Forziati, A. R. Glasgow, Jr., and C. B. Willingham, National Bureau of Standards, Washington, D. C.

Synthesis and Properties of Hydrocarbons of High Molecular Weight—II.

R. W. Schiessler, J .N. Cosby, D. G. Clarke, C. H. Herr, C. S. Rowland, and W. S. Sloatman, The Pennsylvania State College, State College, Pa.

2:00 P. M.

DIVISION OF PRODUCTION

(Red Lacquer Room)

Drilling and Production Practice:

(Sponsored by the Central Committee on Drilling and Production Practice)

Presiding: Paul D. Torrey, Consulting Engineer, Houston, Texas.

A Review of Recent Advances in Drilling-Mud Control.

Preston E. Chaney, Sun Oil Co., Beaumont, Texas.

A National Survey of Dual-Well Completions.

W. A. Alexander, Shell Oil Co., Inc., Houston, Texas.

Prediction of the Shrinkage of Crude Oils.

D. L. Katz, Associate Professor of Chemical Engineering, University of Michigan, Ann Arbor, Mich.

Hydration-Pressure Relationships in Clays and Heaving Shales.

H. H. Power, Professor of Petroleum Engineering; Barnaby L. Towle, Shell Research Fellow; Joseph B. Plaza, Graduate Student—The University of Texas, Austin, Texas.

Note:

Open discussion will follow presentation of each paper.

Wednesday, November 11, 1942, 9:30 A.M.

(Grand Ball Room)

DIVISION OF REFINING

Refining Problems and Processes:

Corrosion Protection of Storage Tanks.

F. L. Newcomb, Standard Oil Development Co., Elizabeth, N. J.; C. F. Kelly, Humble Oil and Refining Co., Baytown, Texas; and E. S. Dixon, The Texas Co., Port Arthur, Texas.

The Thermofor Catalytic Cracking Process.

T. P. Simpson, L. P. Evans, C. V. Hornberg, and J. W. Payne, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.

Critical Analysis of Sweetening Processes and Mercaptan Removal.

John Happel, S. P. Cauley, and H. S. Kelly, Socony-Vacuum Oil Co., Inc., Brooklyn, N. Y.

9:30 A. M.

DIVISION OF PRODUCTION

(Private Dining Room 17)

Pipe-Line Transportation Problems:

Presiding: C. H. Kountz, Sinclair Refining Co., Pipe-Line Department, Independence, Kans.

Address:

Major J. R. Parten, Director of Transportation Division, Office of Petroleum Coordinator for War, Washington, D. C.

An Analysis of Certain Circuits in Cathodic Protection.

Gordon N. Scott, Pipe-Line Technologist, Los Angeles, Calif.

Volumeter Practice in the Petroleum Industry.

E. E. Ambrosius, University of Kansas, Lawrence, Kans., and E. W. Jacobson, Gulf Research and Development Co., Pittsburgh, Pa.

Note:

Open discussion will follow presentation of each paper.

(Continued on page 58)

Maintenance of compressor engines

Information supplied by "World Petroleum"

Wartime demand for compressors and possible difficulties in obtaining replacements for their prime movers make necessary care in servicing this important equipment. A few simple precautions will prolong their life and prevent unnecessary shutdowns.

Keeping the magneto wire compartment closed keeps out dirt and minimizes bearing wear and wire corrosion.

Correct plug spacing helps economical operation and eliminates undue magneto trouble. Keep a spare set of plugs on hand.

Warming up a cold engine before putting it under a heavy load prevents many a cracked cylinder or head.

Never turn water on a hot engine. Shut down until it cools off.

Unloading of compressor cylinders should precede every engine start.

The load should be balanced on all cylinders at all times.

Keeping the compressor cylinder piping clean prevents excessive cylinder wall and piston wear and the breaking of valve discs and pit seats.

Never permit the oil level in the engine crankcase or lubricator to become too low. If the lubricator reservoir becomes dry each pump may require re-priming.

It often pays to filter fuel gas to remove rust or scale. The filter usually can be combined with the scrubber.

Consistent observance of these details goes far in maintaining dependable compressor operation.

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9:30 A. M.

DIVISION OF PRODUCTION

(Red Lacquer Room)

Conservation and Allocation Practices:

Presiding: F. E. Heath, Sun Oil Co., Dallas, Texas.

Present Allocation Practices in the Various States.

D. R. McKeithan, Phillips Petroleum Co., Bartlesville, Okla.

Coordination of Conservation Practices in Various States.

E. G. Dahlgren, Secretary, Research and Coordinating Committee, Interstate Oil Compact Commission, Oklahoma City, Okla.

Note:

Open discussion will follow presentation of each paper.

Wednesday, November 11, 1942, 10.00 A.M.

(Crystal Room)

Board of Directors:

10:00 A. M.

Meeting of Board of Councillors:

(Private Dining Room 14)

to nominate candidates for election as members of the Board of Directors.

2:30 P. M.

General Session:

(Grand Ball Room)

Report of Board of Councillors and Election of Directors.

Address:

William R. Boyd, Jr., President, American Petroleum Institute; Chairman Petroleum Industry War Council.

Address:

Hon. Harold L. Ickes, Secretary of the Interior, Petroleum Coordinator for War, Washington, D. C.

8:00 P. M.

General Session:

(Grand Ball Room)

Address:

Hon. Joseph B. Eastman, Director of the Office of Defense Transportation, Washington, D. C.

Address:

Speaker to be announced.

Thursday, November 12, 1942, 9:00 A.M.

DIVISION OF PRODUCTION

(Red Lacquer Room)

Drilling and Production Problems—

Office of Petroleum Coordinator for War:

Presiding: John R. Suman, Humble Oil & Refining Co., Houston, Texas.

Address:

E. DeGolyer, Assistant Deputy Coordinator, Office of Petroleum Coordinator for War, Washington, D. C.

Address:

D. R. Knowlton, Director of Production, Office of Petroleum Coordinator for War, Washington, D. C.

Address:

E. Holley Poe, Director of Natural-Gas and Natural-Gasoline Division, Office of Petroleum Coordinator for War, Washington, D. C.

Address:

William B. Heroy, Director of Reserves Division, Office of Petroleum Coordinator for War, Washington, D. C.

Address:

Greer W. Orton, Director of Materials, Office of Petroleum Coordinator for War, Washington, D. C.

Report of Division's Nominating Committee.

H. S. Moss, H. S. Moss Petroleum Co., Dallas, Texas, Chairman.

Election of Twenty Members of the General Committee of the Division of Production.

Note:

Open discussion will follow presentation of each paper.

9:30 A. M.

DIVISION OF REFINING

(Grand Ball Room)

Refining in Wartime:

Looking Ahead at Refining.

Bruce K. Brown, Assistant Deputy Coordinator, Office of Petroleum Coordinator for War, Washington, D. C.

Paper.

Speaker to be announced.

Refinery Construction in Wartime.

Max B. Miller, Chief, Equipment Procurement Section, Refining Division, Office of Petroleum Coordinator for War, Washington, D. C.

Refinery Conversion for War.

T. G. Delbridge, Chairman, Technical Advisory Subcommittee of the Committee on Synthetic Rubber of the Petroleum Industry Council; The Atlantic Refining Company, Philadelphia, Pa.

Report of Division's Nominating Committee..

L. L. Davis, Continental Oil Co., Ponca City, Okla., Chairman.

Election of Twenty Members of the General Committee of the Division of Refining.

10.00 A. M.

Executive Committee of Board of Directors.

(Private Dining Room 8)

Thursday, November 12, 1942, 2:00 P.M.

(Grand Ball Room)

General Session:

Address:

Ralph K. Davies, Deputy Petroleum Coordinator for War, Washington, D. C.

Presentation of, and brief remarks by, members of the staff of the Office of Petroleum Coordinator.

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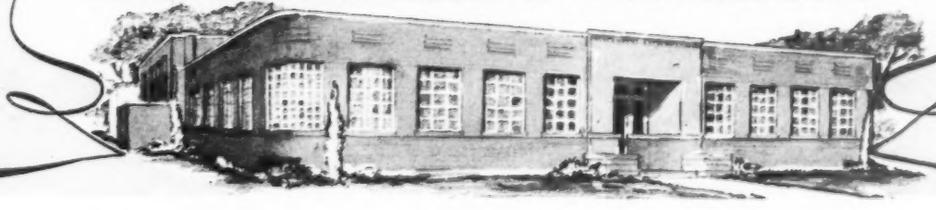

★ HOUSTON ★ TEXAS

FOREIGN OIL LEGION

LIEUT. E. W. MAYO, JR., U.S.N.R.

Earl W. Mayo, Jr., managing editor of WORLD PETROLEUM, has been granted leave of absence for the duration of the war. Mr. Mayo who recently received a commission as Lieutenant, U.S.N.R. reported for duty at the Quonset (R.I.) naval station, on October 19. Lieut. Mayo has been associated with WORLD PETROLEUM since 1931 and through his numerous trips to oil producing areas in the United States and in foreign countries has acquired a wide circle of acquaintanceship throughout the industry. Being a salt water enthusiast and keenly interested in naval affairs he turned naturally to this branch of the service when the opportunity to join the armed forces presented itself. His associates and members of the staff join in wishing him Godspeed in his new assignment.

CORRECTION

In the article "Control of Oil Resources in Relation to War" by Rear Admiral Harry A. Stuart and R. G. Tracie, published in October WORLD PETROLEUM an inadvertent error occurred in the statement that the Near East Development Company, representing the American financial interest in the Iraq Petroleum Company and associated corporations, was owned by Standard Oil Company (New Jersey). As is well known in the oil industry the Near East Development Company, in which five American oil corporations originally participated, is now owned jointly by Standard Oil Company (New Jersey) and Socony-Vacuum Oil Company.

EMSCO VICE PRESIDENT

William T. Powell has been appointed a vice president of the Emsco Derrick & Equipment Co., effective October 1, 1942. Mr. Powell was born in Treorchy, Wales, and entered the Emsco organization on August 1, 1937. He has been manager of the War Materials Division since that division was organized in June, 1941 and up to the time of his present appointment.

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WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry — Edited by Dr. O. W. Willcox.

DRILLING

Completion Practices Related to Well Productivity—W. J. Travers, Jr., in PETROLEUM TECHNOLOGY, March, 1942, T. P. 1465, 8 pages.

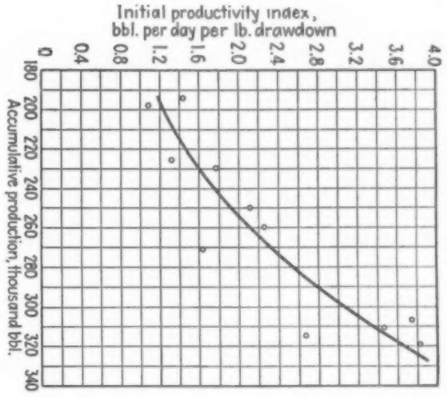
Several new procedures for completing oil wells have been developed in recent years. Each method when used where properly applicable promises to be a definite aid to operators in lowering development or operating costs, or in developing the full potentialities of the oil well.

Since in each case the new procedure developed is an alternate of older conventional methods, a problem of selection is presented. The purpose of this paper is to suggest methods of arriving at these choices and to present practical observations that may be of aid in their application.

The author proceeds to set forth the salient points of multiple zone completions in contrast to the older practice of setting a solid water string over each zone to be produced; gravel packing in unconsolidated formations, and the use of light weight bentonitic clay muds and oil base drilling fluids to eliminate mud damage to producing sand faces. Concerning gravel size in gravel packing he has this to say:

Since any natural reservoir contains a certain portion of extremely fine sand and silt, it is desirable that the gravel size be large enough to allow this material to move through the gravel and be produced with the oil. Otherwise, a relatively impermeable silt sheath will be formed around the outside of the gravel. Because of this unavoidable hole condition, any formula for determining gravel size (eight, ten or twelve times the diameter of the sand at the 10 percentile point on the screen analysis) should be applied only if the resulting minimum gravel size indicated is not smaller than 3/16 inch.

In the matter of drilling-in, it is strongly recommended that if a water base mud is used, the drilling-in should be speeded up as much as possible so as to give little time for a mud sheath to form. Where the oil sands have low permeability, application of an oil-base drilling fluid is particularly advisable.



Since there are numerous completion practices, some are likely to be better than others in particular cases. How is the operator to judge whether he has selected the right one? There is

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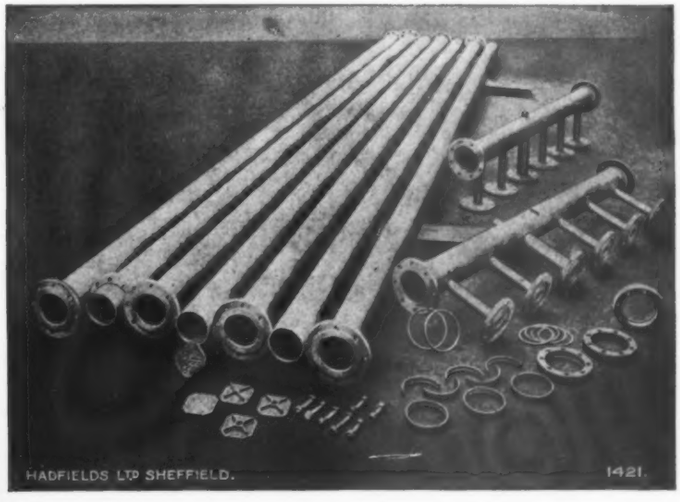
Highly resistant to the attack of numerous chemical agents.



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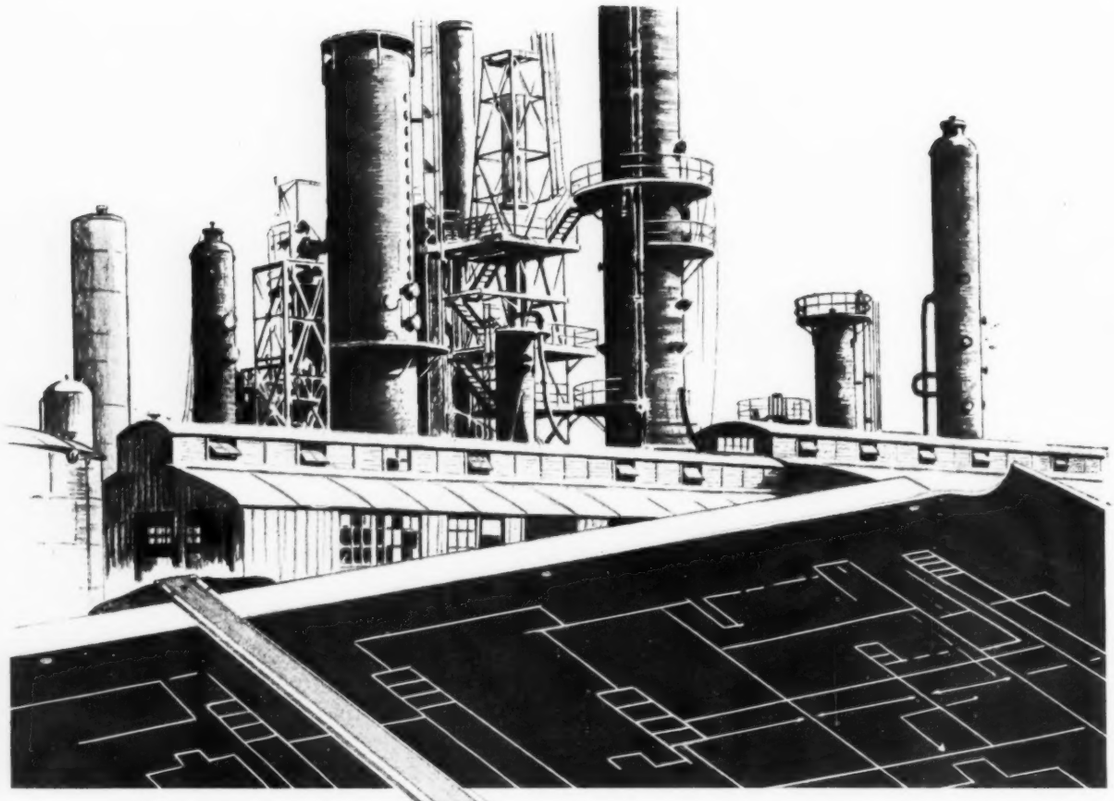

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The problem arose how to recover the variable finely divided particles in a fluid catalyst refining process. Quietly in cooperation with others, Western Precipitation Corporation set about to solve this problem—after much research and experimentation the blue prints became realities, the equipment was installed. Soon actual plant operations justified the anticipations of all. The problem had been solved—Western Precipitation Corporation's thirty-five years of experience in kindred fields had made it possible.

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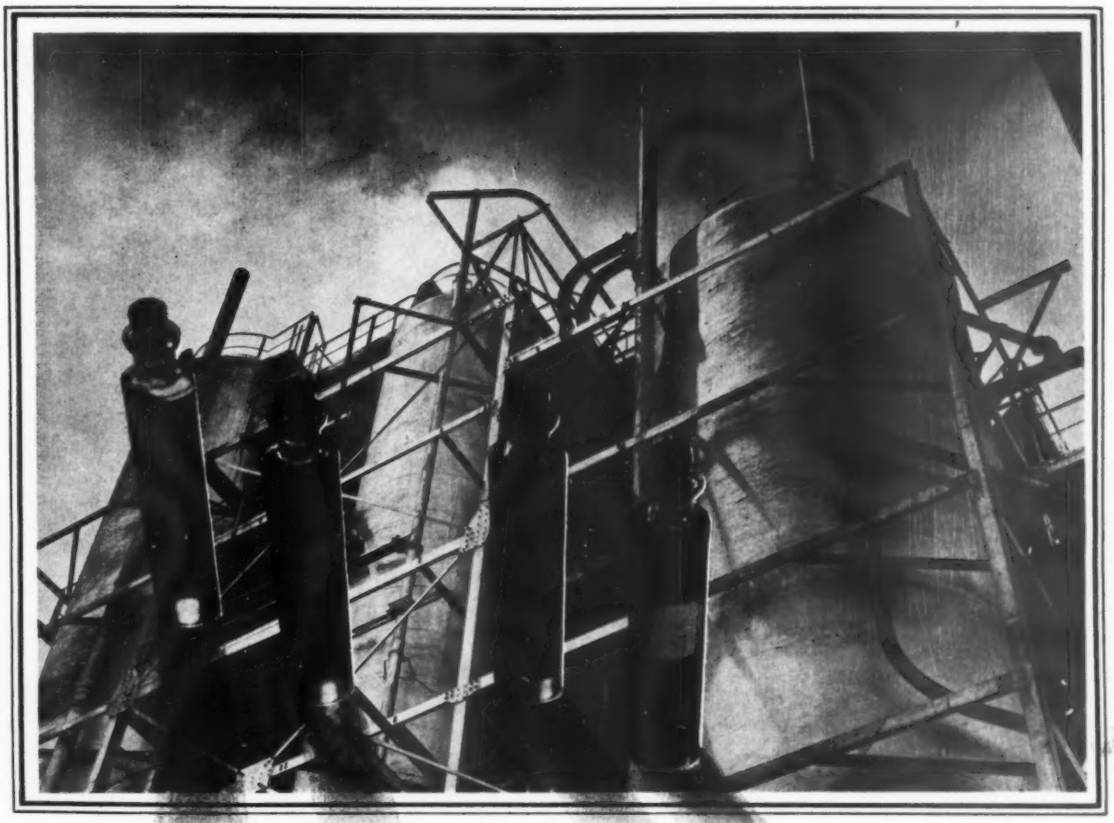

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no absolute rule in this matter, but apparently the most logical test is the initial productivity index in terms of barrels produced per pound of drawdown of bottom-hole pressure. The ultimate test of a completion method is the final amount of oil produced by a well that taps a given formation, and there is a fairly definite relation betwen initial productivity index and accumulative production. This is shown in the accompanying diagram, based on wells in the Wilmington field.

Drilling-time Logs and Their Uses—Robin Willis and R. S. Ballantyne, Jr., in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 26 (1942), No. 7, pp. 1279-1283.

In rotary drilling the rate of penetration, or drilling-time, may prove a useful aid in logging the formations encountered. Drillers do more or less subconsciously observe the rate at which the hole goes down, but very seldom record the actual time required to make each foot of hole; yet such observations take little effort or time, and when made enable the geologist to plot a curve that is useful for a variety of purposes. The method is simple, and consists in marking the Kelly in feet with chalk or pipe dope. The driller has a pad of printed forms and a watch on a convenient portable stand and records the time when each foot mark reaches the Kelly bushing, omitting time when bit is off bottom, or not running. The curve is plotted to show minutes per foot. It is convenient to note weight, table speed, pump pressure, change of bit and type of bit. The author says that he has had no difficulty in getting the drillers to cooperate in making accurate logs.

The most obvious use of drilling-time logs is for purposes of correlation, often with near-by wells. This saves many cores and electric-log runs, and sometimes permits recognition of faults and other irregularities of section; correlation by drilling-time is possible in holes drilled with oil, where coring and electric logging cannot be used.

Drilling-time logs may aid in the recognition of formations. Use of these logs with corresponding electric logs makes exact interpretation of "shells" and other anomalies possible where use of the electric log alone might well result in a wrong conclusion. The determination of depleted oil sands is perhaps of most practical importance.

The question of which part of a core has been recovered may be answered by the drilling-time log if a series of distinct formations has been cored. The formation breaks should be plotted against the drilling-rate breaks. Consequently, the lost part of the core may be located and a more precise correlation made possible.

Graphic time logs, made with drill-pipe measurements, can usually be correlated accurately with the electric log to check the measurement of the latter, and correct them to correspond. Gun-perforating measurements can likewise be referred to drill-pipe measurements by checking a bottom or liner top so established. Cores are also logged on drill-pipe depths. In this way, all data and operations are referred to the same method of measurement, and the question of absolute accuracy is replaced by assurance of relative correspondence.

Well Facing and Production Interference in West Columbia Field—John C. Miller, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 26 (1942), No. 9, pp. 1441-1466.

The West Columbia field in Brazoria County, Texas, is one of the few older prolific fields that has available detailed individual well-production and other data suitable for use in a comprehensive study of well spacing in terms of ultimate recovery and well interference. These data, supplemented by information gained by introducing fluorescin directly into the producing horizon, migration of the fluid in the reservoir could be proved over a distance of 800 feet up dip. and 420 feet laterally. Production interference between wells was established over distances of 400-500 feet.

The fact that the high recovery of 1100 barrels per acre foot of sand depleted, obtained from a well spacing of 17.5 acres per well, was not exceeded by recoveries of much denser spacing and the evidence of well interference over distances of 400-500 feet, with further evidence of drainage to 800 feet, leads to the conclusion that the West Columbia field would have been properly drained under a uniform wider spacing program of at least 17.5 acres per well.

Correlation of Certain Properties of Oil-Well Drilling—Fluids with Particle—Size Distribution—George L. Gates and C. P. Bowie, in BUREAU OF MINES REPORT OF INVESTIGATIONS, B 645 (1942).

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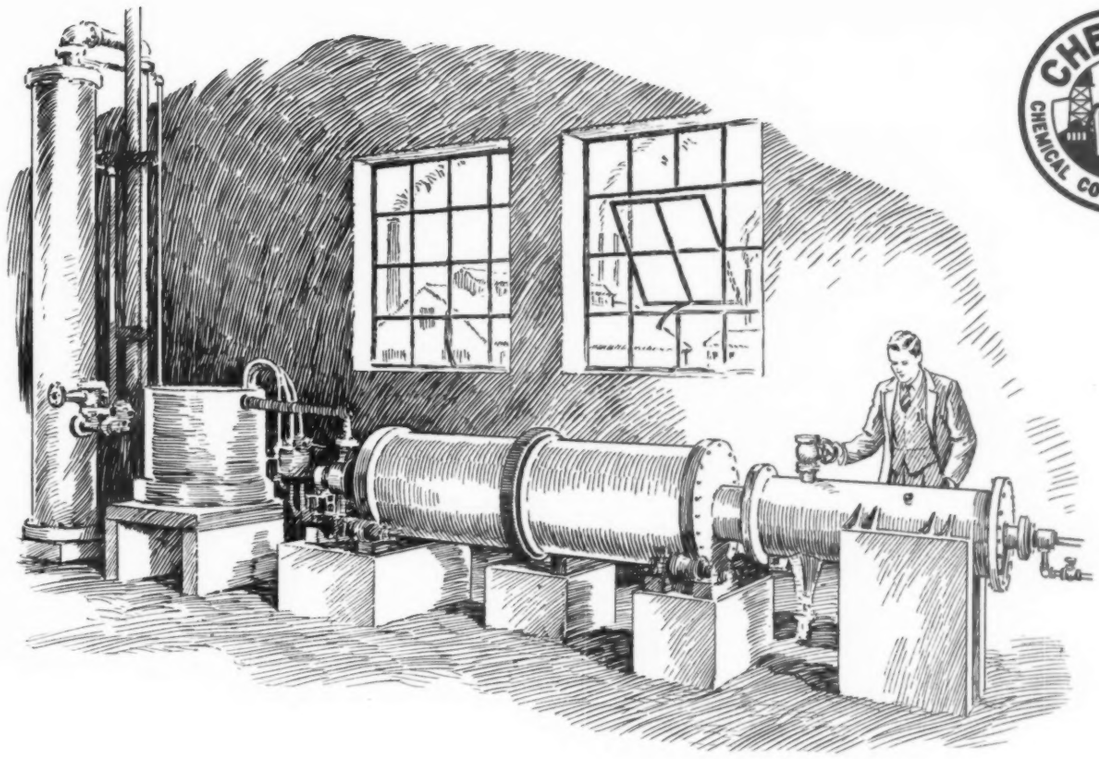

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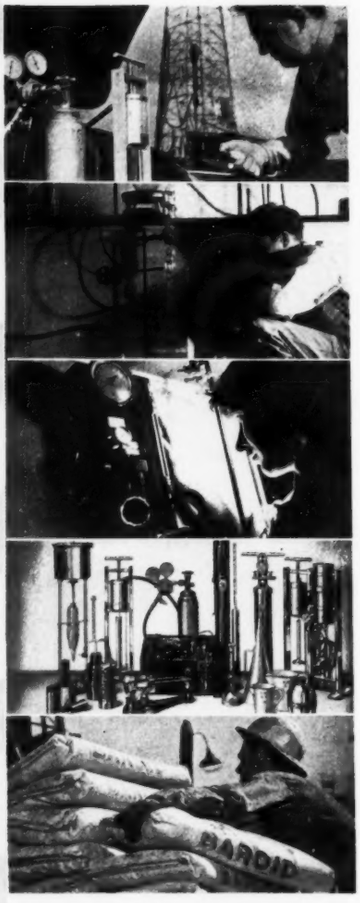

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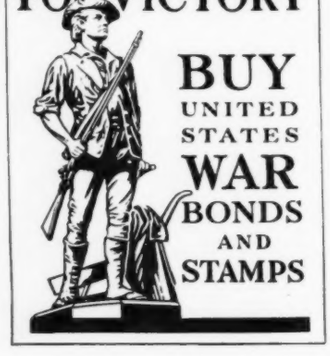

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fluid is its filtering rate, or the rate at which a sheath of it will pass liquid into the formations penetrated by the hole. Obviously, a low filter rate is desirable. This work gives definite quantitative confirmation to the general opinion that for a low filter rate there must be a uniform distribution of particle size and a sufficient amount of colloidal material. Samples found to have the lowest filtering rate had an average content of 65 per cent (by weight) of colloids, 30 per cent of silty material and 5 per cent of sand. By contrast, drilling fluids containing not above 6 per cent of colloids, 87 per cent silt and the rest sand had the highest filter rates.

OPERATION

Determination of Oil-Well Capacities from Liquid Level Data—Charles C. Rodd, in PETROLEUM TECHNOLOGY, July, 1942, Technical Paper No. 1475; 9 pages.

The advantages of conducting well tests without interfering with production are apparent, particularly where production is not restricted and down time means loss of income. Even where runs are restricted and down time does not involve loss of allowable, the expense of pulling rods and tubing is more than the cost of an extended study with liquid-level measuring equipment, which in Kansas has been largely in connection with official tests for allocation purposes. Prior to the use of drawdown tests, physical tests were required, which on most pumping wells necessitated the installation of large-capacity equipment costing from $7,000 to $12,000 per well, and required pumping the wells at rates that often were considered to be injurious to the reservoir. As well allowables were extremely low, the capacity of the equipment was not utilized, except for physical tests, for several years after installation. Since the adoption of drawdown tests, most operators are installing smaller equipment costing from $2,000 to $5,000 per well, and are pumping the wells at much lower rates than formerly.

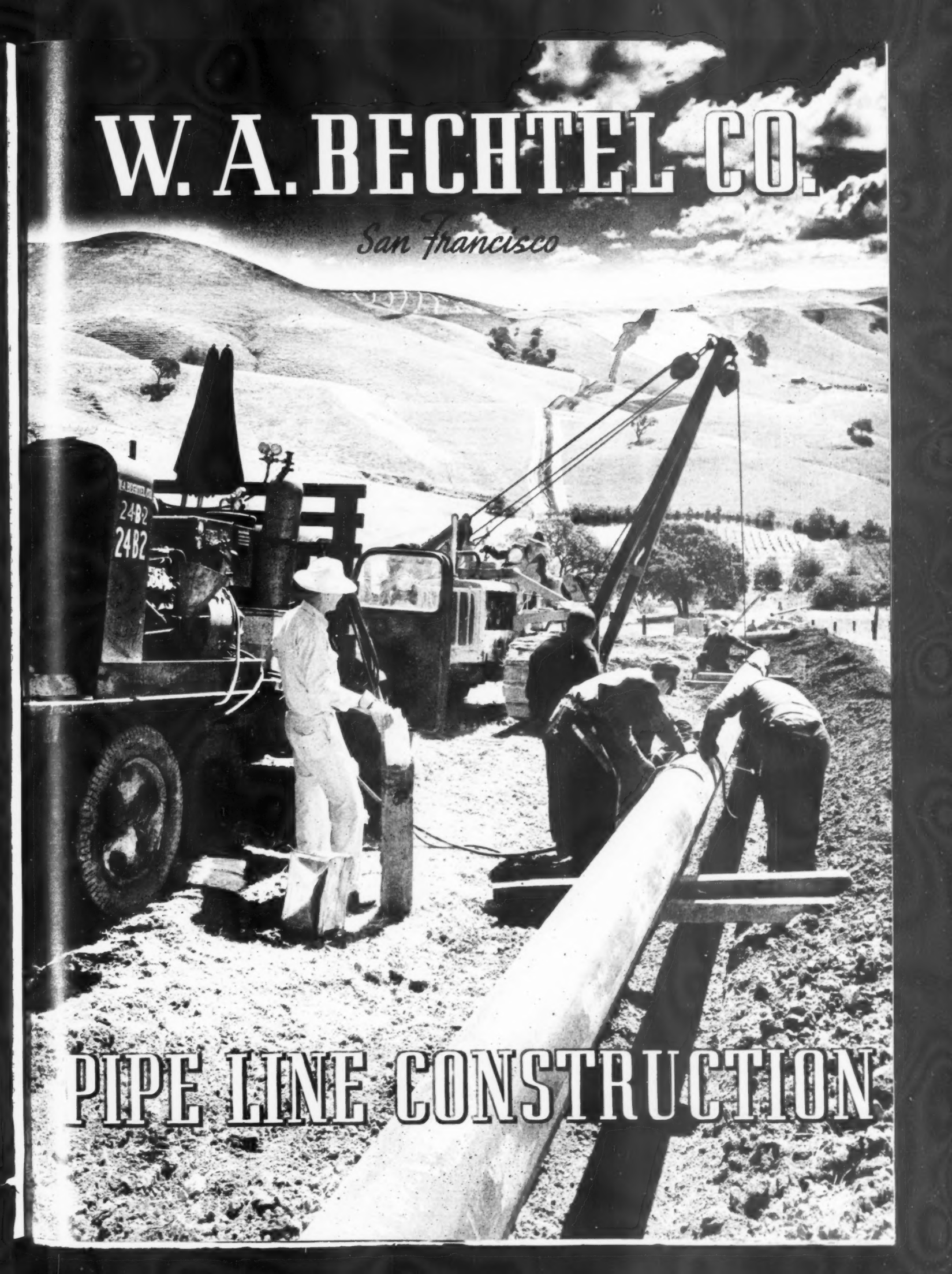
The service cost of testing a pumping well varies from approximately $40, where liquid-level data alone are used, to approximately $140 for a back-pressure test requiring the use of a compressor. Labor cost varies from $10 to $25, depending on the type of test. The average cost of taking capacity physical tests, including labor and repairs to equipment, but excluding depreciation of pumping equipment, is approximately $125 per well.

Most flowing wells (and some pumping wells if properly equipped) can be tested more cheaply with bottom-hole pressure gauges than with liquid-level measuring equipment. Pressure gauges, however, are costly, and only a few operators own them.

PIPE LINES

Recent Developments in Cathodic Protection of Bare Pipe Lines—G. R. Olson, before PETROLEUM INDUSTRY ELECTRICAL ASSOCIATION, Cathodic Protection Section, Shreveport Meeting, April, 1942.

The main problem in protecting a buried pipe line from destruction by corrosion is the economics of the case. The proposition is to keep the line in good condition for the longest possible time at the least possible cost. Digging out an old line and reconditioning it involves an expense that is to be avoided or postponed by all economically available means.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PIPE LINE CONSTRUCTION

Measures to insure long life for a pipe begin when the line is laid and take the form of extra wall thickness and an external protective coating of one kind or another; these initial measures are then supplemented by a system of cathodic protection. Extra wall thickness and protective coatings figure largely in the investment cost; cathodic protection is a continuing cost.

In this paper the author takes up the question of dispensing with extra thickness of pipe-wall and protecting coatings, and depending only on cathodic protection. In other words, he addresses himself to the question of protecting bare lines. To illustrate his point he makes use of experimental data obtained by the United Gas Pipe Line Company with certain of its Texas lines that were buried without coatings, or with poor coatings. A total of about 60 miles of such line was involved in the experiments. The design consisted of building an electric power line parallel to the pipe line, using ten 35-ft. poles per mile and a single 2300 volt conductor which was used as a common return for the primary and secondary circuits to the soil and the line, thus eliminating the need for two extra pole-line conductors. Transformers were spaced at 1½ mile intervals to step the 2300 volt current down to 110 volts. Details of construction and operation are given in the paper.

The system has not been in operation long enough to conclusively prove all points, but some favorable results are quite apparent. For instance, the system was applied to an old 8-inch bare pipe line 20.9 miles long south of Wichita Falls, Texas. On April 1, 1941, this line was developing corrosion leaks at the rate of 525 a year. Through the effect of the new system of cathodic protection the number of these leaks had dropped to 105 in the succeeding 12 months. This is a reduction of 5 to 1, and it is known that a large percentage of these 105 leaks were due to a marked increase of operating pressures during the fall and winter, which blew out old weak spots. Similar experience is reported from other sections of line in various districts.

The author suggests that this experience may be of special significance in these times when everything possible is being done to assist the war effort by reducing the drain on critical materials. He illustrates this point by calculations applied to 15 separate installations where it was a question of applying cathodic protection now, or reconditioning or replacing the pipe 5 years hence; it turned out that if the reconditioning were not made now, 1996 tons of new critical materials would be needed, whereas if presently made only 223 tons would be needed.

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CHEMISTRY

Production of Butadiene by Single-Stage Catalytic Dehydrogenation of Butane—V. I. Komarlwsky and C. H. Reisz, in OIL AND GAS JOURNAL, Vol. 41 (1942), No. 19, pp. 33; 37-39.

Up to the present the conversion of butane to butadiene for the manufacture of synthetic rubber has been a two-stage process; normal butenes are obtained in the first stage and these are then dehydrogenated in the second stage to produce butadiene. The same catalyst is used in both stages but under different conditions of pressure and temperature; much carbon is deposited on the catalyst in both stages, so that very short on-stream periods of operation are necessary.

These authors have now found that by employing certain operating conditions butadiene can be produced from butane in a single-stage procedure. These conditions are a temperature of 1202° F., a pressure of about 100 mm. absolute mercury in the catalyst chamber and a contact time of 0.24 second. Under these conditions the yield was 13 per cent on the weight of butane. Lower temperature (1112°) and a shorter time of contact (0.1 second) gave a smaller yield but no carbon was deposited on the catalyst, which permits a longer run between regenerations. By recycling, 74 weight-per cent of butadiene may be produced, with deposition of only 2.3 weight-per cent of carbon on the catalyst.

The above work was done in the laboratory. The project has been transferred to a pilot plant which is operated as follows: Butane is heated to the reaction temperature by means of heat exchange with the reactor gases and by an auxiliary heater. The butane is catalytically dehydrogenated in the catalyst reactor which is of special design and which has provision for revivification of the catalyst. The vacuum maintained on the catalytic reactor may vary from 10 to 300 mm. absolute mercury pressure while the temperature may lie in the range 1020° to 1200° F. The reactor gases are cooled by heat exchange with the charge and by a final cooler. The cooled gases pass through a pump system which compresses the gases to the pressure required in the recovery system. The product is fractionated in a separator where the light gases

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including hydrogen and C_1 to C_2 gases are removed. A portion of the hydrogen may be recycled as a further aid to the single-stage process in keeping the catalyst free of carbon. The C_4 gases including butadiene, *n*-butenes and *n*-butane pass to an absorber when butadiene is selectively absorbed by a solvent. Butadiene is recovered by stripping the enriched solvent. The gases coming from the absorber contain *n*-butenes and unreacted *n*-butane and are recycled to the reactor.

BOOKS

Chemical Refining of Petroleum, by Vladimir A. Kalichevsky and Bert Allen Stagner; published 1942, by Reinhold Publishing Corporation, New York, revised edition, 550 pages, $7.50.

As the title indicates, this volume presents the theory and practice of the various chemical processes used in refining petroleum and its products, and in improving certain desirable characteristics of the finished products. The need for such a book has been proved by the exhaustion of the first edition, and it is now presented in a new and largely rewritten second edition.

The text covers practically the whole range of the application of chemicals to petroleum purification as now practiced on a commercial scale. These processes are grouped under the convenient heads of sulfuric acid treatments and their various objects and effects, treatment with alkaline reagents, sweetening operations and the elimination of sulfur, refining by absorbents (clays), and refining by solvents. Treatment of end products includes the use of anti-knock reagents in gasoline, inhibitors and anti-oxidants, gums and their control, treatment of lubricating oils. The contents of the various chapters are more extensive than the above short list might seem to indicate. Practically every phase of the chemical refining of petroleum receives notice, affording the refinery technologist a large mine of information. In addition there is an extensive digest of United States patents on refining processes; each Chapter is provided with a bibliography, and the author and subject indexes are very full.

GENERAL

Substitute Fuels, A War Economy of World Dimension—Gustav Egloff and P. M. Van Arsdell, before AMERICAN CHEMICAL SOCIETY, Petroleum Division, Memphis Meeting, April, 1942.

According to available information the Axis nations are relying to a considerable extent on substitute fuels. These substitutes include gasoline from hydrogenated coal and the Fischer-Tropsch plants, benzol, compressed gases from natural gas, coal, and carbonization units, city gas plants, and sewage. Other substitutes in line of their importance are alcohols, wood, coal, coke, ammonia and acetylene. Before the war much encouragement was given to development of wood-gas generators for driving busses and automobiles, but their use has created wood shortages of such acuteness that streets were deprived of their wooden paving blocks, and forests were being cut down to a timber shortage. This has forced a redesign of these generators to burn peat, of which some countries have large supplies. Every available source of alcohol fuel is being utilized, including grapes, waste sulphite liquor, and even the alcohol vapors given off by fermenting dough in large baking establishments.

Substitute fuels and petroleum have made 122,700,000 barrels of fuel available to the Axis countries. At the end of 1941 it was estimated that there were a total of 107,225 compressed gas vehicles which released approximately 2,553,000 barrels of liquid fuels, and a maximum of 373,145 producer gas vehicles in use in Europe, which saved about 7,780,000 barrels of oil fuel. Approximately 13,200,000 barrels of benzol and alcohol were produced on the European continent in the same period and 233,000 barrels of shale oil also had been produced. Sweden and Spain planned to produce greater quantities of shale oil from their undeveloped resources.

Until Axis control is established in some large oil producing country, the need for greater quantities of substitutes will be present since the Russian invasion has cost Germany about 21,500,000 barrels per month, of which at least 4,250,000 barrels must be used in maintaining communications and industry behind the battle lines.

During 1940 considerable progress was made in adapting the motors of Europe to the use of substitute fuels, and also in building plants for the manufacture of synthetic motor fuel. The quantity of petroleum and substitute fuels produced throughout Axis Europe amounted to a maximum estimate of 128,329,000 barrels, and consisted of gasoline from petroleum, coal and water gas; compressed gases; wood, alcohol benzol, and shale oil.

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